NOVEMBER
1953

MECHANICAL ENGINEERING

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ASME ANNUAL MEETING—New York, N. Y., November 29-December 4, 1953

WHY ARE THEY REBUILDING THE POWER PLANT?

One morning soon workmen will start removing a turbine and its four associated boilers from The Ohio Power Company's Philo Plant near Zanesville, Ohio.

In these days of heavy power demand, this will be an unusual procedure, especially since this *was* one of the most efficient electric generating units of its day.

Why are they doing it? *And why should you care?*

They are removing this old unit from the plant to make room for the most unusual steam generator-turbine unit in the world. This new apparatus will generate three times as much electricity at almost twice the efficiency of the old unit, yet the new unit will require no additional building space and little additional circulating water.

How is it possible to add this large block of highly efficient capacity at Philo Plant?

It is possible because for the first time in history, power plant designers, steam boiler engineers and turbine designers, working as a team, have reached a point where they can smash a natural barrier that has threatened further progress in steam-electric generation. The barrier is "critical pressure," the precise pressure (3206 pounds per square inch) at which it becomes impossible to separate steam and water because they have the same density.

The story behind this achievement goes back over the years. Fifteen years ago, Babcock & Wilcox, in cooperation with the American Gas and Electric System, designed and built an advanced boiler for 2650 pounds per square inch. This boiler, and the special turbine developed for it, established at that time a new level of efficiency for converting fuel into electric energy. It was an important factor in establishing the outside limits of what could be done *below* the critical pressure. The great strides of the entire electric utility industry in thermal efficiency since that time have been largely within this framework and based on this experience.

Why is it advisable to replace the old unit at Philo?

Our country runs on electric power and the electric utilities are determined to keep it "America's best bargain." Power engineers can never relax their drive, therefore, for higher levels of operating efficiency as well as lowered capital investment.

So—even as they were developing today's efficient electric generating plants—power engineers were seeking ways to crack the pressure barrier they knew they would ultimately reach. Thirty years ago—long before there was a commercial need—B&W was exploring, at considerable cost, the properties of steam at pressures *above* the critical point and as high as 5000 pounds per square inch. This study became part and parcel of multi-million dollar research into all phases of combustion and steam generation.

The result of this ceaseless activity is B&W's Universal Pressure Boiler, a steam generator that can operate *above or below* critical pressure with equal facility. The first unit for the Philo Plant will have a design pressure of 5500 pounds per square inch. The steam temperature . . . unprecedented at this pressure . . . will be 1150 F.

Many other advanced engineering features will be incorporated in this new boiler. Notable among them will be the Cyclone Furnace, B&W's revolutionary method of firing coal that greatly simplifies the fuel-firing system, increases combustion efficiency, and greatly reduces fly-ash discharge to the atmosphere.

Paralleling research in boiler design has been the cooperative efforts of turbine engineers and many other designers to develop the machines to utilize this high-pressure, high-temperature steam.

Why are they rebuilding the power plant? To make room for progress—to make the lights burn brighter and the wheels turn faster, in pursuit of the American dream. They are doing this because the American Utility Industry . . . dedicated to public service . . . will never cease the struggle to surpass its own best efforts.

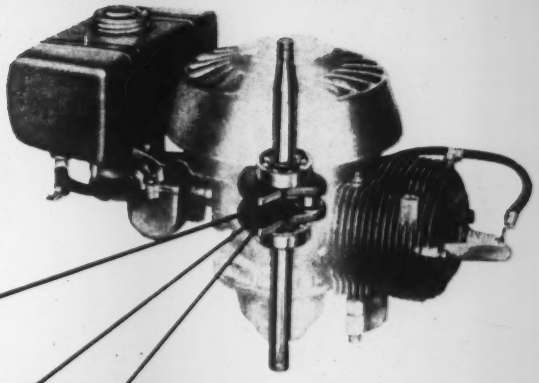
And why should you care? Press a light switch, or snap on your television set, or take a look at the electric bills for running your office or factory. There's your answer. Only free men, laboring in a free economy, could make this possible.

BABCOCK & WILCOX

BOILER DIVISION

N-157

This Lightweight's a Heavy Worker!



Yard work is really fun with a Lightweight-powered midget tractor.

Cutting a tree is as easy as falling off a log . . . with Lightweight power.

Mowing a lawn is light work with 12-pound Lightweight gas engine.

Jack-of-all-trades . . . master of *every* one—that's Power Products' 12-pound Lightweight Engine! This versatile power plant has proved itself in scores of applications where light weight is a factor. Its makers credit much of its success to the New Departure ball bearings which support the crankshaft. *New Departures made 15 major improvements possible* . . . such as higher power, lower upkeep, *much* longer life!

In fact, New Departures can improve *any* product that demands low-friction, rigidly accurate support of moving parts. In everything from heavy industrial to sensitive instrument applications, American business can call on New Departure's research, engineering and manufacturing facilities —most extensive in the ball bearing industry.

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE

BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

Also Makers of the Famous New Departure Coaster Brake

MECHANICAL ENGINEERING, November, 1953, Vol. 75, No. 11. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional; to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

AIR CIRCUIT DESIGN AND COST SIMPLIFIED BY AIR CYLINDER WITH BUILT-IN VALVE . . .

VALVE AND ALL OPERATING CONTROLS ARE INTEGRAL WITH THE CYLINDER. Only one air connection is required.

In pneumatic circuits the closer the valve to the cylinder, the faster, more economical and more efficient is the operation. The advantages of "close-coupling" are universally recognized by pneumatics engineers. But only Bellows offers the ultimate in "close-coupling" — an air cylinder and valve as one integral unit.

This unique Air Cylinder, with its built-in valve, is known the world over as the Bellows Air Motor. It has brought a new simplicity and effectiveness to pneumatics operation. It has created an entirely new conception of the use of air power in production processes.

In the decade since the first Bellows Air Motor was built almost 20,000 manufacturers have installed these compact power units. In many plants as many as a thousand Air Motors are in use; in many plants Bellows Air Motors operate 24 hours a day, month in, month out, building operating records of thirty, forty, even fifty million cycles.

No matter what you make, how big or how small your plants, you can use Bellows Air Motors to speed production and cut costs in a host of operations.

THIS 36-PAGE BOOKLET TELLS THE STORY . . . .

Just off the press. Filled with data every production man can use. Free on request.

Write Dept. ME1153 The Bellows Co., Akron, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto 18, Ontario, Canada.

The Bellows Co.

AKRON 9, OHIO

***"CONTROLLED AIR POWER"* FOR FASTER, BETTER, SAFER PRODUCTION**

Not A Flight of Fancy

HERE ARE WAYS CHIKSAN CAN HELP AIRFRAME MANUFACTURERS

The airplane shown here is not an actual picture of any one plane. Rather, it is a composite to show some of the varied ways in which Chiksan planning can help the airframe manufacturer do a better job.

Fuel, oil, water, air and oxygen all find dependable, safe, uninterrupted flow through Chiksan aero-hydraulic swivel joints and assemblies.

The Flow of Enterprise Relies on

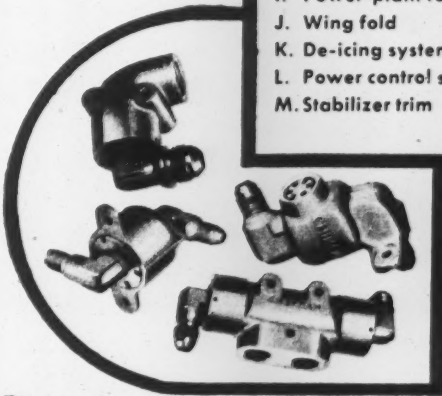
CHIKSAN

Ball-Bearing Swivel Joints

REPRESENTATIVES IN PRINCIPAL CITIES

CHECK THESE APPLICATIONS IN YOUR BLUEPRINTS:

- A. Refueling boom assembly
- B. Steering control mechanism
- C. Brake system
- D. Spoiler actuating mechanism
- E. Fuel and oil lines
- F. Adjustable sweep-back system
- G. Emergency dump chute
- H. Flap actuating system
- I. Power-plant fuel and oil lines
- J. Wing fold
- K. De-icing system
- L. Power control system
- M. Stabilizer trim



A few of the many Chiksan aero-hydraulic swivel joints made for pressures ranging from 1000 to 3000 psi.

CHIKSAN

AUTOMATION STARTS WITH WESTINGHOUSE MOTORS AND CONTROLS

How *Life-Line* motors improve the performance of this Microhoning machine

Production Microhoning on this machine requires close work. Tolerances as close as tenths of thousandths of an inch are held with automatic, faultless duplication. Engineering such accurate performance, designers found Westinghouse Motors offered definite advantages.

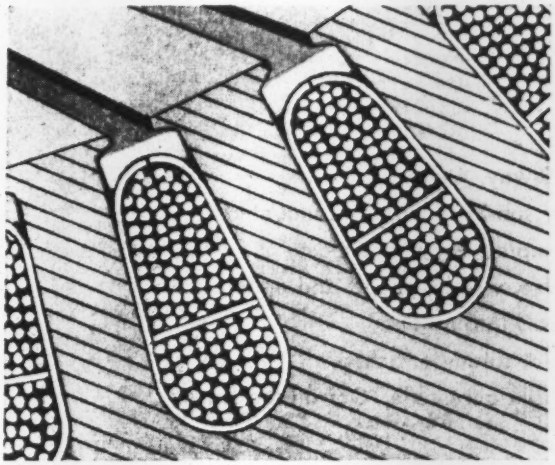
For example, vibration in Life-Line* Motors has been reduced to the minimum. As a result, no matter how close the motor is mounted to the work or to the tool, tolerances are not affected . . . accuracy remains constant. This is possible because each Life-Line rotor is dynetrically balanced to within .001 of an inch deflection . . . below the limits normally held.

Continuity of motor operations, so vital to this automatic production, is assured with Westinghouse Life-Line Motors. Factory-sealed, pre-lubricated bearings, standard on all Life-Line Motors, eliminate bearing failures from faulty lubrication or the entrance of dust and dirt. Machine stoppage for bearing replacement is thereby erased. This bearing advantage permits Life-Line Motors to be mounted in confined areas without providing access for on-the-job greasing . . . makes over-all machine design more compact.

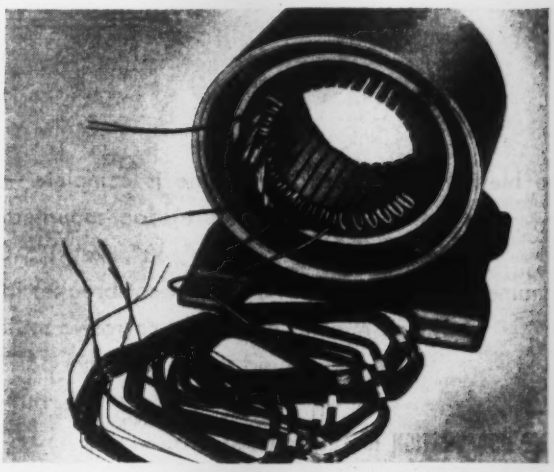
For idea literature that will help you in properly applying motors, ask your local Westinghouse representative for Booklet B-5458, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-21737

*Trade Mark

YOU CAN BE **SURE**...IF IT'S
Westinghouse



Life-Line rotors are dynetrically balanced to within .001 of an inch to reduce vibration to a minimum. As a result, Life-Line Motors are ideally suited to close-tolerance machine tool work.



Pre-lubricated, factory-sealed bearings, standard on all Life-Line Motors, have been tested and proved by thousands of users under all types of conditions. Dirt is locked out . . . grease sealed in.

Diversatility rides again in the new COMPLETE line of SPEED KING Valvair Solenoid Pilot Operated Control Valves

Valvair Speed Kings are small, light in weight, with a speed of 600 cycles per minute, and proven capable of 20,000,000 cycles and up.

The New Valvair Speed King line is complete — 3-way, 4-way, and 4-way-5-port (2-pressure), foot-mounted or sub-base manifold mounted; pipe sizes — ¼", ⅜", ½", ¾", 1". *Complete* — to fit almost innumerable applications. A precedent-breaker in size, weight, speed and endurance. Only one moving part. Non-corrosive materials throughout. Solenoid and pilot valve parts are totally enclosed, but easily accessible. *Get all the facts!*

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Looking for solutions to all piston ring problems?

It will pay you to look to Koppers . . . here's why:

Every Diesel, gas engine, pump and compressor presents a different piston ring problem. So it pays to go to the source that can look for the solution from every angle . . . Koppers American Hammered!

In one complete, modern plant, American Hammered produces rings for every industrial application . . . in sizes ranging from less than one inch to ten feet in diameter. Ready to serve you are large foundries equipped for both static and centrifugal casting . . . a modern heat-treating plant . . . one of the largest and most up-to-date chromium plating plants . . . modern machine shops . . . an efficient engine test laboratory . . . a modern and complete piston ring research laboratory.

Outstanding product quality, assured by trained metallurgical and engineering staffs . . . supplemented by field engineers, thoroughly familiar with ring applications . . . results in efficient service and analysis of your specific problem. For experienced help with *your* problems, mail this coupon. No obligation, of course.

Compression Ring is a one-piece, quick-seating piston ring. One-piece construction gives maximum strength. Turned finish on outside diameter enables ring to conform readily to cylinder bore. Chemically treated surfaces promote rapid seating with freedom from scuffing or scoring during run-in. 1½" to 120" diameters.

Porous Chromium Plated piston rings are manufactured by the exclusive Van der Horst process. Produced with a shallow porosity on the cylinder contacting surface, this ring facilitates break-in, holds and distributes oil during this critical period. Lasts four times longer and cuts cylinder wear up to 75%. ½" to 42" diameters.

Conformable Oil Ring maintains constant unit pressure for positive oil control. Conforms readily to meet cylinder distortion because flexible cast iron member is pressed outward by abutment type spring which exerts uniform radial pressure around entire circumference. 4" to 25" diameters, ¼" min. width.

Koppers Seal Ring has either one of two projecting bands of bearing bronze inserted in its cylinder contacting face. High unit pressure on narrow bronze bands takes quick initial seat, tends to prevent blow-by in both new or worn cylinders. Burnishing action of bronze on cylinder walls decreases scuffing and wear. 2" to 30" diameters.

Grooved Oil Cutter Ring has been adapted as standard equipment where oil control has previously been a major problem. Unique design incorporates two bevels for riding over oil on upstroke, plus a series of wide drainage slots. 1½" to 25" diameters.

Plus Ring Materials to fit every need, such as: K-IRON®, a high grade, closely controlled, individually cast grey iron used in majority of applications . . . and K-SPUN®, a malleable type iron, centrifugally cast for applications requiring high strength, high elastic modulus and superior impact resistance.

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IN EVERY SIZE
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FOR EVERY PURPOSE

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I'd like help with my piston ring problem.

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Company.....

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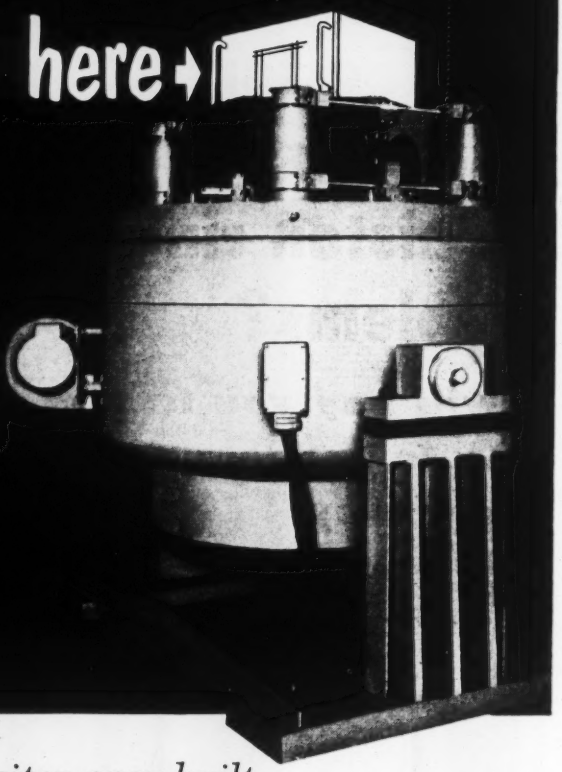
City.....State.....

Put your product here → to shake-test it with 10,000 lbs force



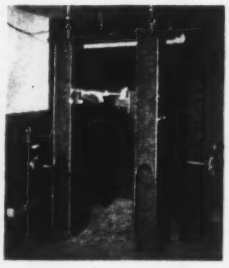
MB produces the largest exciter ever built to meet heavy duty vibration test specifications

THERE'S nothing like a good shaking to test out structural designs, electronic equipment, instruments or complete assemblies for faults or flaws. In fact, for many products put to military use, such tests are *specified*. However, since *all* products encounter some vibration or shock in service, many engineering departments use an MB Exciter to test all designs. By so doing, the "bugs" are discovered in the test laboratory instead of out in the field, at cost of good will.

Largest in the line of MB electromagnetic shakers, the Model C-100 shown delivers at least 5 tons continuous force. Its performance permits heavy duty vibration testing to MIL-E-5272 and other specifications. It incorporates a number of unusual design features for easy, quick, convenient operation—including interlocking controls for complete safety and provisions for cycling tests.

HOW TO HANDLE LARGE MASSES

MB can show you a setup of vibration exciter and resonating beam that multiplies the capacity of versatile MB Exciters many fold. Shaker being used in this fatigue strength test of aircraft engine mounts is the model S-3 rated at 200 lbs. Others available down to 10 lbs. force output.



Vibration is MB's specialty. You're invited to draw on the benefits of this specialization—and get highly qualified products for testing and control, and technical help on your problem.

Valuable bulletins for test engineers Calibrating vibration pickups to 2000 cps is comprehensively covered in MB Bulletin No. C-11-4. Bulletin No. 1-VE-4 describes vibration exciters and details their specifications. Write today.

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Leading architects, engineers and contractors know from the long record of repeated user approval that they can depend on Sarco performance.

The Sarco heating specialties now operating in this new office building and other Lederle Laboratories buildings have been installed over a period of 18 years. Several thousand Sarco steam traps, radiator valves and traps, air eliminators, strainers, and temperature controls are giving satisfactory performance.

For dependable heating specialties and all around satisfaction, you can confidently specify Sarco.

On your request, we'd be happy to send you full information on Sarco's complete line.

FOUR REASONS WHY IT PAYS TO SPECIFY SARCO

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2. Trouble-free Service
3. Complete Line from One Reliable Manufacturer
4. Nationally Known and Preferred by Users.

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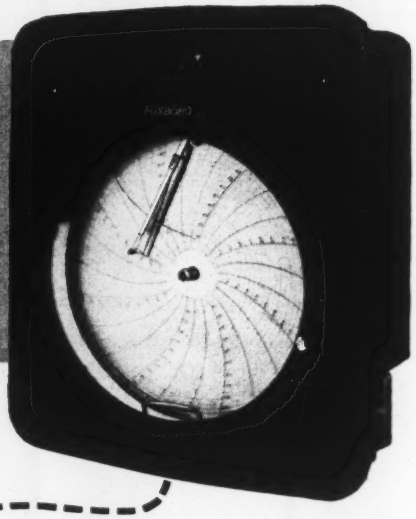
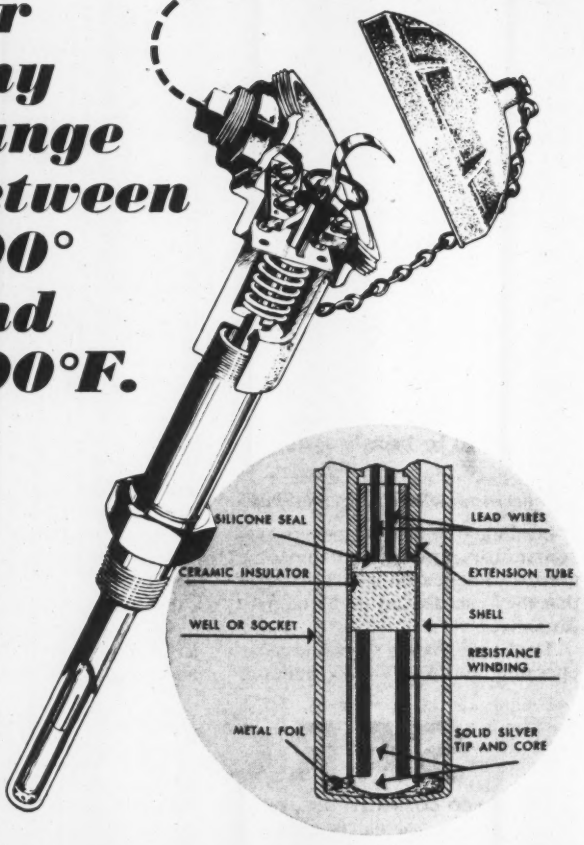


for any range between -100° and +600°F.



You can't beat this Foxboro Dynalog-Dynatherm combination for insuring better temperature measurement on any job between–100° and+600°F. It gives you every advantage of speed, accuracy, long leads, simple installation, economy, and freedom from maintenance. This is why:

The Dynalog Electronic Recorder has an exclusive variable-capacitor measuring system which eliminates slidewires, gears, cables, high speed balancing motors . . . no dead space, no batteries to standardize, no motors to service. Standard full-scale pen speed only 3 seconds. Sustained accuracy ¼ of 1% guaranteed. Available for spans as narrow as 5°F. with full-accuracy calibration.

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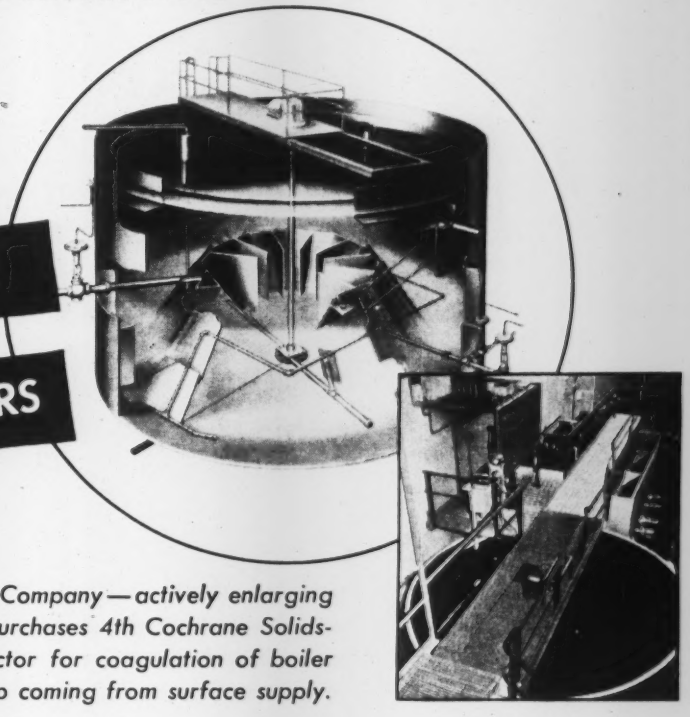

Duke Power Company — actively enlarging capacity — purchases 4th Cochrane Solids-Contact Reactor for coagulation of boiler feed make-up coming from surface supply.

• This record of repeat orders is evidence of successful design and performance. Units are being built for coagulation, lime softening, iron removal, fluoride removal, white water recovery in paper mills, cooling water treatment, process water clarification, tin plate rinse water, oil field flooding water and similar applications.

They can be built in small sizes—such as for the bottling trade, or in very large sizes—such as for paper mills, up to 110′0″ dia., capable of handling more than 20,000,000 GPD in a single unit.

Write for new Solids-Contact Reactor Catalog—Publication 5001-A —just off the press.

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Hot Process Softeners • Deaerators • Dealkalizers • Demineralizers • Reactors • Continuous Blow-Off • Specialties • C-B Systems

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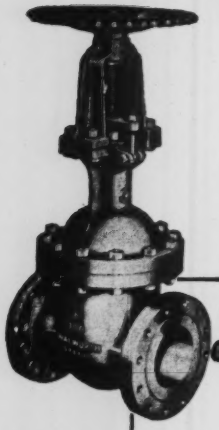
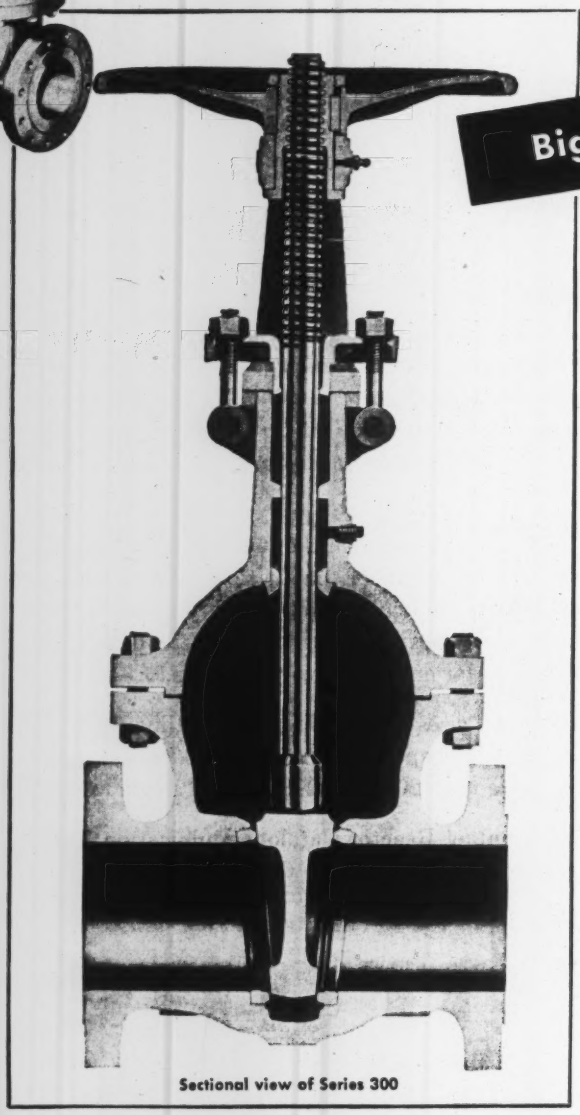
Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

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Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

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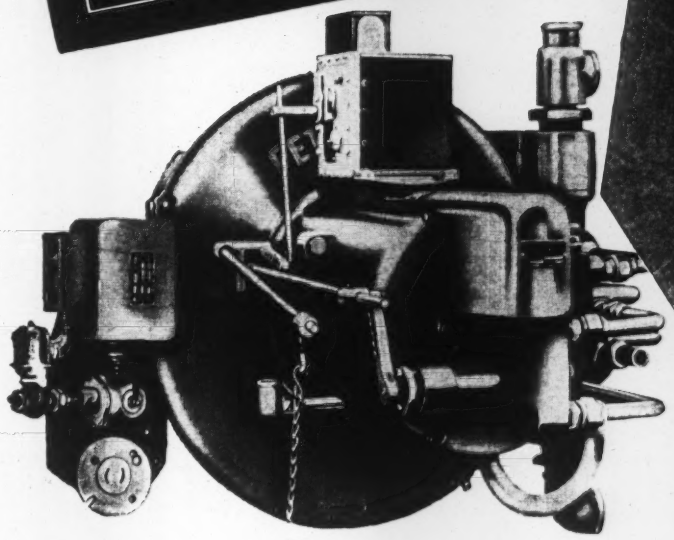

and cut steam costs!

HERE'S WHAT PETRO WILL DO FOR YOU:

LOW FIRST COST

Petro industrial oil burners are designed and built to *modernize* the firing of your present boilers. This means that you save substantially on initial installation costs—yet enjoy the efficiency, the dependability, and the complete automatic operation that has been traditional with Petro burners for over 50 years.

LOWER FUEL COSTS

A Petro oil burner's economy is unchallenged. You save two ways. First, you save on fuel cost, because heavy oils cost less per gallon and have higher heat value. And second, a Petro burner is designed to burn these low-cost, heat-rich heavy oils with complete dependability. Whether the oil is thick or thin a Petro feeds it steadily under precise automatic control. You get more efficient firing.

UNUSUAL FLEXIBILITY

Here is another Petro value. Under automatic modulating flame control it is extremely flexible in following fluctuating steam demands. If yours is a problem of "high and low" steam requirements—then a Petro burner is your answer. It follows the load without hesitation, and throttles down to a steady low burning rate if desired.

LOWER OPERATING COSTS

Petro industrial oil burners and combustion oil-gas burners are completely automatic. They require a minimum of supervision. Boiler rooms stay clean. The simple, sturdy design of the Petro burner and its easy accessibility reduce upkeep to a minimum—save you money year after year.

Leading heating contractors everywhere recommend and install Petro oil burners. See your contractor, or mail coupon below.

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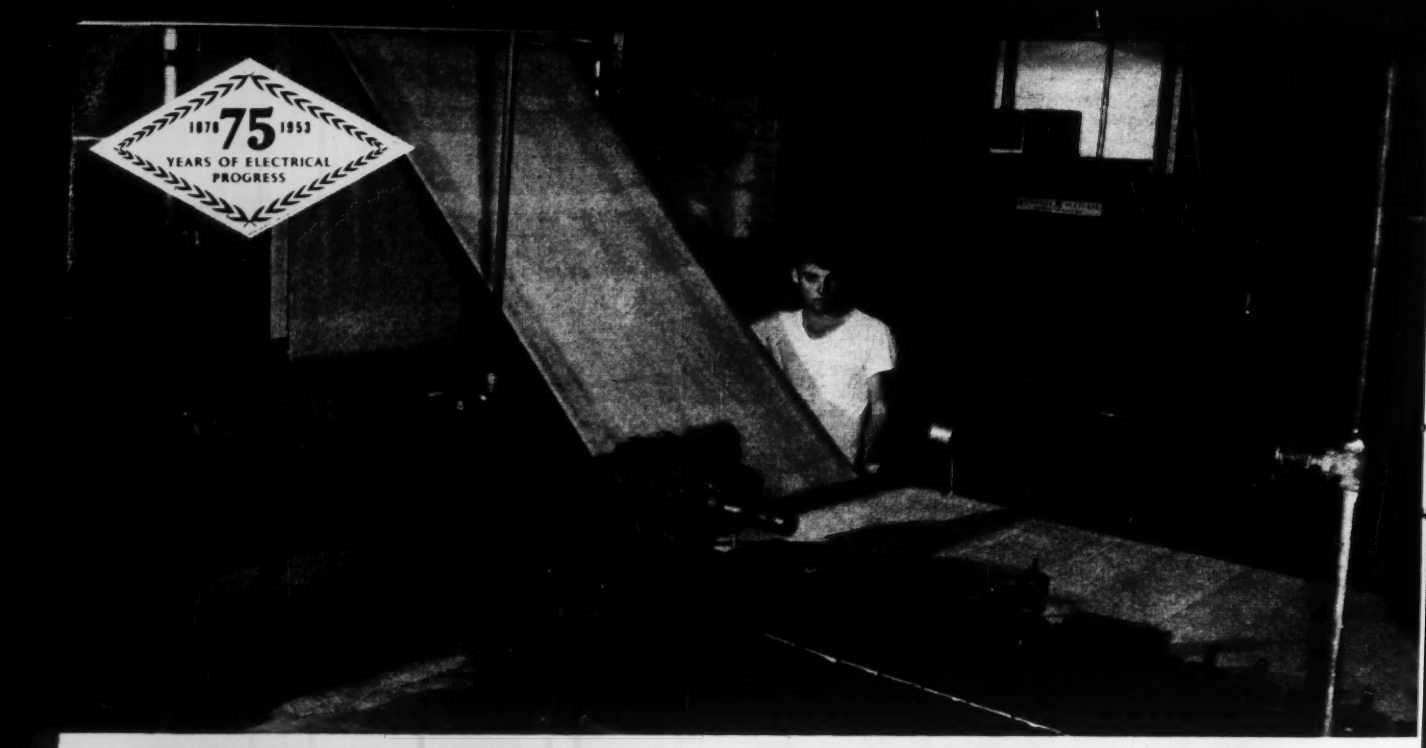
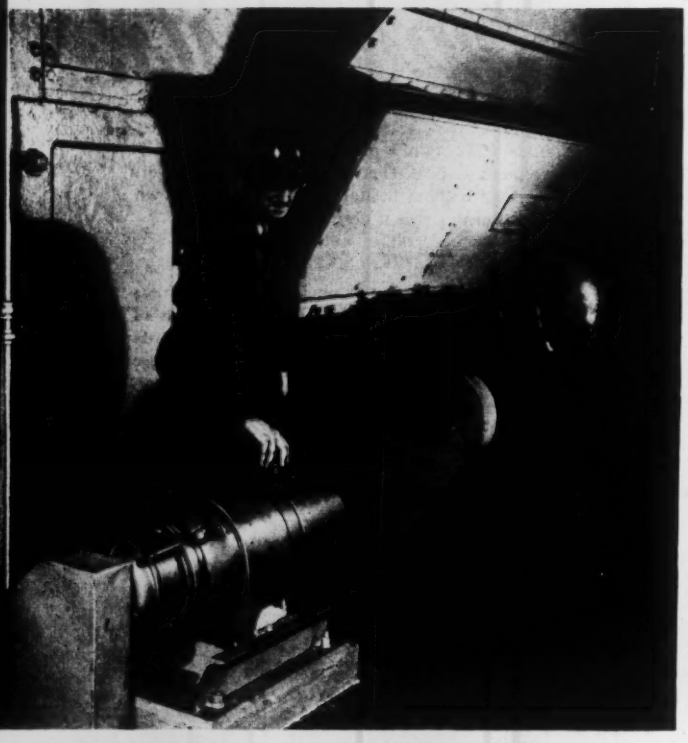
Address _____

City _____ State _____

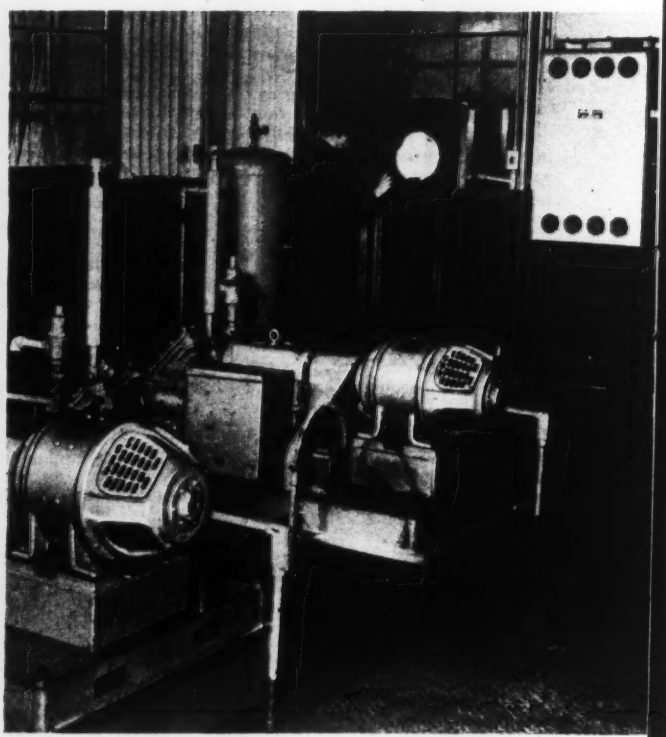


CONTROL SENSITIVITY of the G-E Speed Variator at the Jefferson Mill Inc., Jefferson, Ga., helps cut costs by enabling the operator to speed up the splicing of the cloth rolls . . . enables him to easily control processing speed for any type of cloth. The Speed Variator is a packaged unit . . . easily installed in any convenient location . . . provides your machine with stepless speed control up to a 40 to 1 ratio.

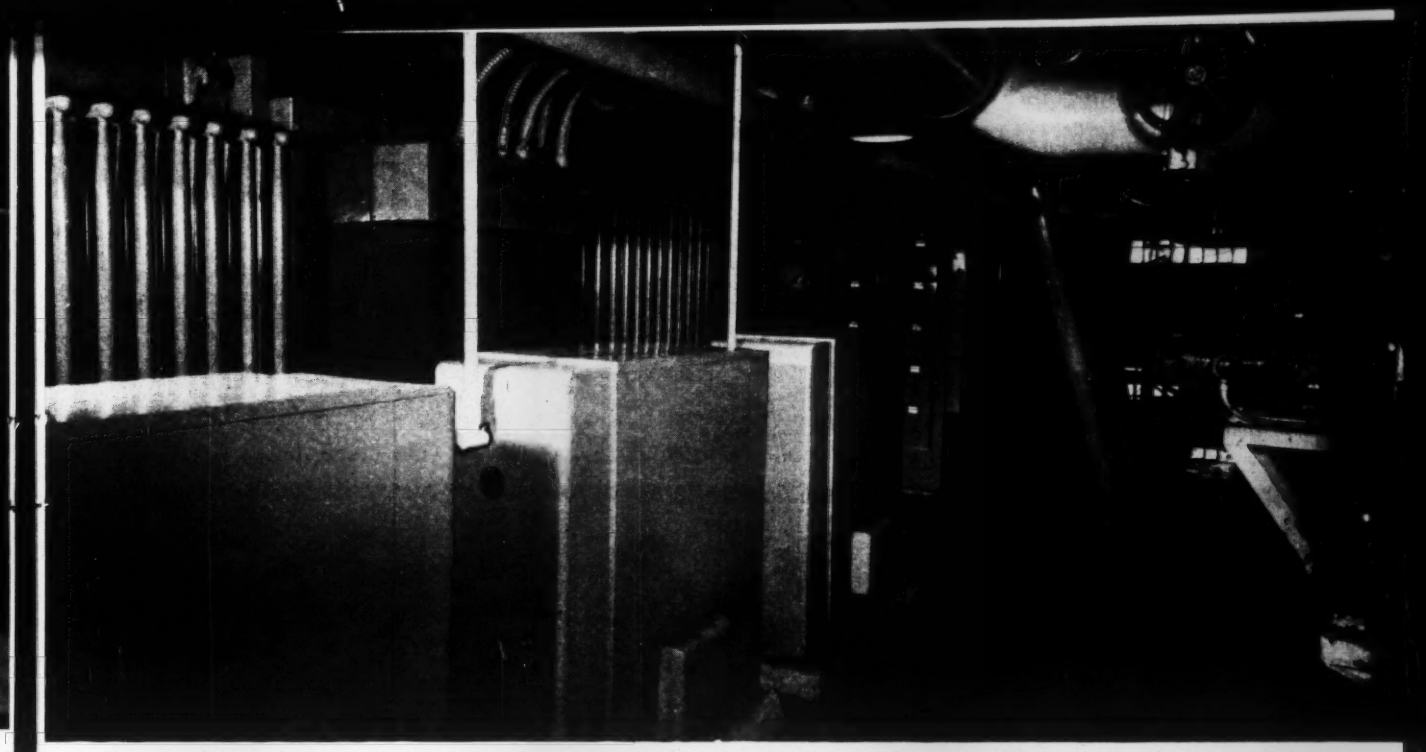
Cut Costs by modernizing your machines



G-E ACA MOTORS now control coal stokers at the Socony-Vacuum Oil Co., Inc., Olean, N. Y. Working directly from AC current the ACA motor offers low cost, low range stepless speed adjustment.



G-E THY-MO-TROL DRIVE accurately controls chemical proportioning pumps at Fibreboard Products, Inc. East Antioch, Calif. This electronic drive offers precise control in speed ranges up to 100 to 1.



G-E SPEED VARIATORS at the Ohio Boxboard Co., Rittman, Ohio, centralize control of various stock preparation processes . . . guard stock thickener speeds. Here you see three of the Speed Variator units—foreground . . . Available in ratings from 1 to 200 hp the versatile G-E Speed Variator can be adapted for even closer speed regulation by the addition of an amplidyne or electronic regulator.

with a G-E Adjustable-Speed Drive!

Here are four manufacturers who have effectively improved one or more of the manufacturing operations in their plants by modernizing their equipment with G-E Adjustable-Speed Drives.

In the same way the proper application of adjustable speed can minimize waste and increase production for you. In addition, adjustable speed by making your present equipment more flexible, will enable you to manufacture a greater variety of goods.

G-E Adjustable-Speed Drives give you economical speed regulation as close as 1% if necessary . . . assure you of correct stepless speed adjustment. Standard drives are available in ratings from 1/40 to 200 hp with speed ranges from 3 to 1 up to 100 to 1.

For full information consult your nearest General Electric Apparatus Sales Office. Your G-E Sales representative will be glad to recommend the most economical drive best suited to your operation. For printed information on the complete line of Adjustable-Speed Drives, use the coupon.

You can put your confidence in—

GENERAL ELECTRIC

LET G.E. HELP YOU PICK THE RIGHT DRIVE

Because only General Electric makes all major types of electric adjustable-speed drives, it is best qualified to help you select the right drive. Send for these informative bulletins.

☐ **A.** This 26-page manual describes all four types of drives and where to apply them. Bulletin GEA-5334.

☐ **B.** Lower cost, simplest a-c drive. Bulletin GEA-4883.

☐ **C.** More flexibility, moderate cost. Bulletin GEA-5335.

☐ **D.** Top performance, 1/40—30 hp. Bulletin GEA-5337.

☐ **E.** Top performance, 1–200 hp. Bulletin GEA-5336.

General Electric Company
Section J646-24
Schenectady 5, N. Y.

Please send me the bulletins checked
☐ for reference only
☐ for planning an immediate project

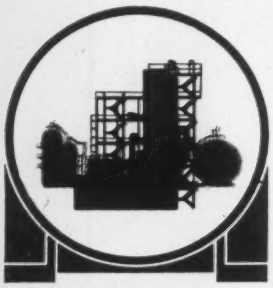
NAME .....

COMPANY .....

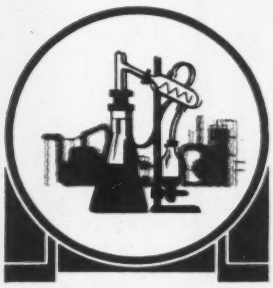
ADDRESS .....

CITY ..... STATE .....

Fuel Pumping



Petroleum Refining



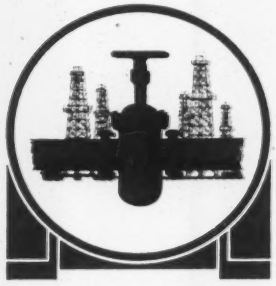
Chemical Processing

Electric Motors

for every industry

When you need electric motors . . . in any rating, or frame type . . . one or a thousand . . . *always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity to *all* industry.

Fairbanks, Morse & Co., Chicago 5, Illinois.



Pipe Line Pumping

Paint Manufacturing

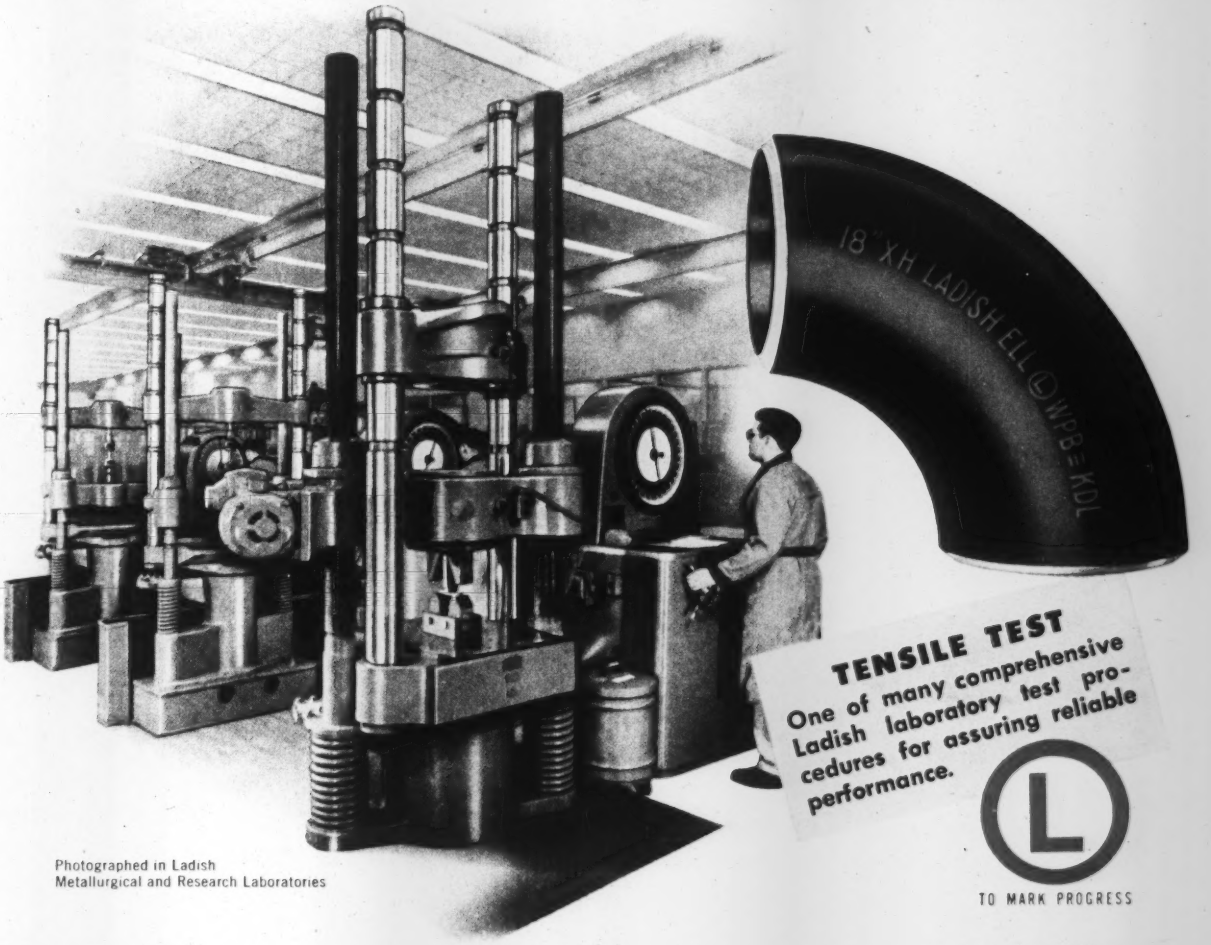
Fairbanks-Morse explosion-proof motors for all installations where fire hazards exist.

FAIRBANKS-MORSE

a name worth remembering when you want the best

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • RAIL CARS • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

LADISH *Controlled Quality* ASSURES METALLURGICAL SOUNDNESS



Photographed in Ladish
Metallurgical and Research Laboratories

TENSILE TEST
One of many comprehensive Ladish laboratory test procedures for assuring reliable performance.

L
TO MARK PROGRESS

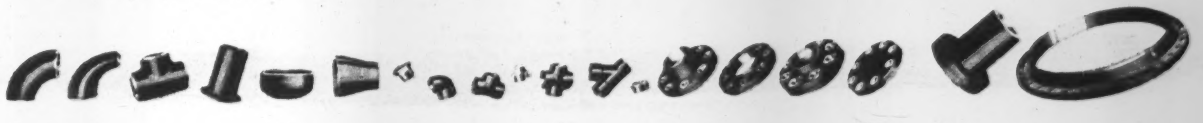
Testing the breaking point of metal... proves Ladish fittings have ample strength to meet the test of maximum service

Optimum strength — proved by scientific test — typifies the outstanding values in Ladish fittings that result from special emphasis on sound metallurgy and advanced facilities. Shown here is modern Universal tensile testing equipment on which ultimate strength, yield strength, reduction of area and elastic properties are carefully measured to assure users of Ladish Controlled Quality fittings the metal quality essential for reliable performance.

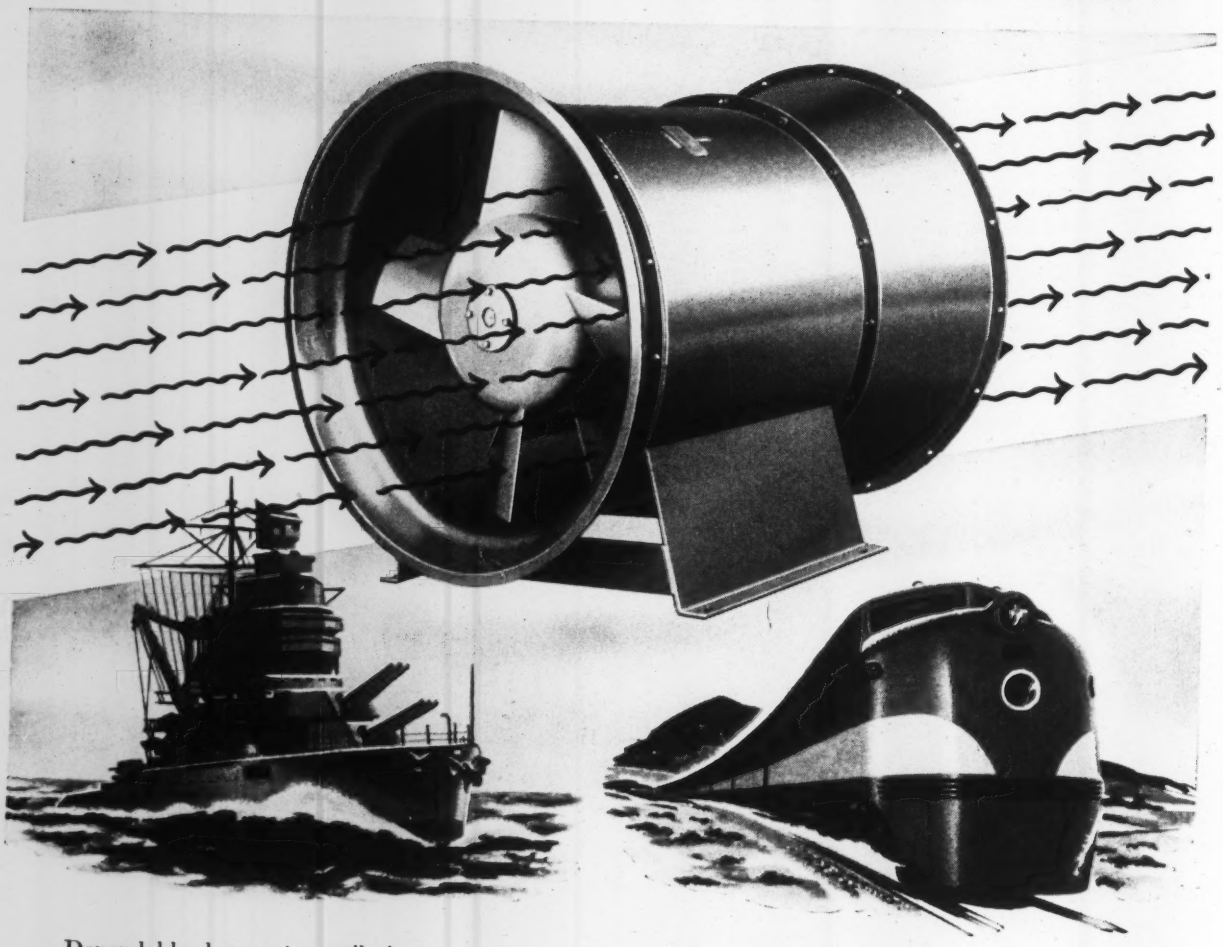
THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF... ONE RESPONSIBILITY

LADISH CO.
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul • St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.



Save with American Blower Axial Fans



Dependable, low cost ventilation!

The Navy demands it on battlewagons . . .

Railroads specify it for modern streamlined trains . . .

Commerce and industry require it for the conduct of profitable business . . .

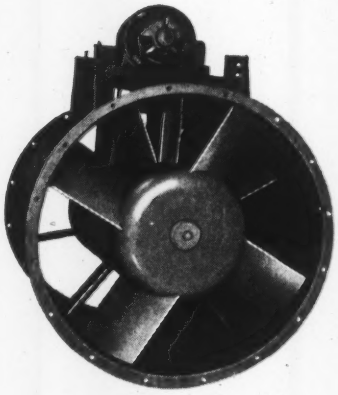
No one company has done more to provide dependable low cost ventilation than American Blower.

For example, American Blower Axial Fans are widely used in thousands upon thousands of varied applications, and are unsurpassed for ease of installation and efficient performance.

For complete information on axial fans and other American Blower Air Handling equipment, contact our nearest branch office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER
YOUR BEST BUY IN AIR HANDLING EQUIPMENT



American Blower Axial Fans are smooth in performance, built for endurance and convenient to install.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

TRADE PAPER EDITION
Published by
SCHUTTE and KOERTING
Company

ENGINEERING News

JET APPARATUS • HEAT TRANSFER EQUIPMENT • ESPRIMERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT •

If You're PUMPING, HEATING, MIXING, SPRAYING, ATOMIZING LIQUIDS, Or If You're HANDLING SEMI-SOLIDS Or SLURRIES, Or If You MUST MOVE, COMPRESS, Or WASH AIR Or GASES And If CORROSION Or EROSION Present A Problem, Then...You NEED What We HAVE—

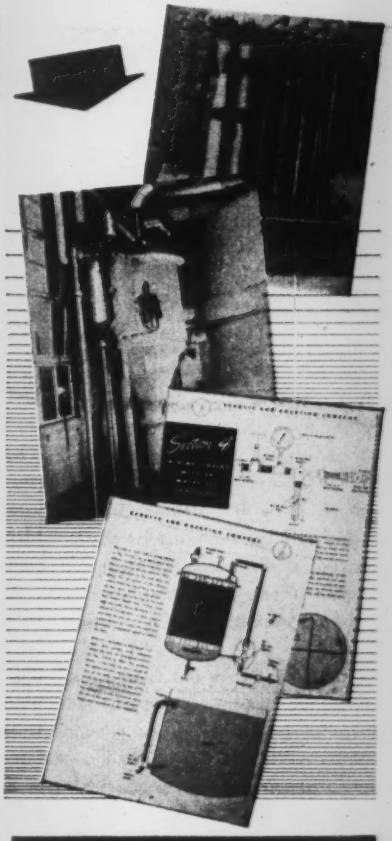
Information On SK JET APPARATUS

SK Jet Apparatus is used in thousands of process operations for performing one or a combination of the headlined functions. Here's why—

Jet Apparatus is exceedingly simple in design and construction, reliable in operation. There are no rapidly rotating parts to wear. It requires little maintenance. Jet equipment is unusually small in relation to the work it does and its cost is correspondingly low. Requiring little attention, a jet may be located in remote and inaccessible places. In many applications, it does what no other equipment can do—pumps *and* heats, entrains *and* scrubs, pumps *and* mixes.

Because Jet Apparatus is so simple in design, a wide range of *corrosion* and *erosion* resistant materials can be used in manufacturing. Depending upon the nature of the material handled, jets can be made from such materials as cast iron, bronze, porcelain, special stainless steels, hard lead, "Durimet," "Illium," "Haveg," "Teflon," Hastelloy, Titanium, stoneware, carbon, PYREX brand tubing, and others. Jet equipment can be lined with lead, rubber, phenolic resins, other materials.

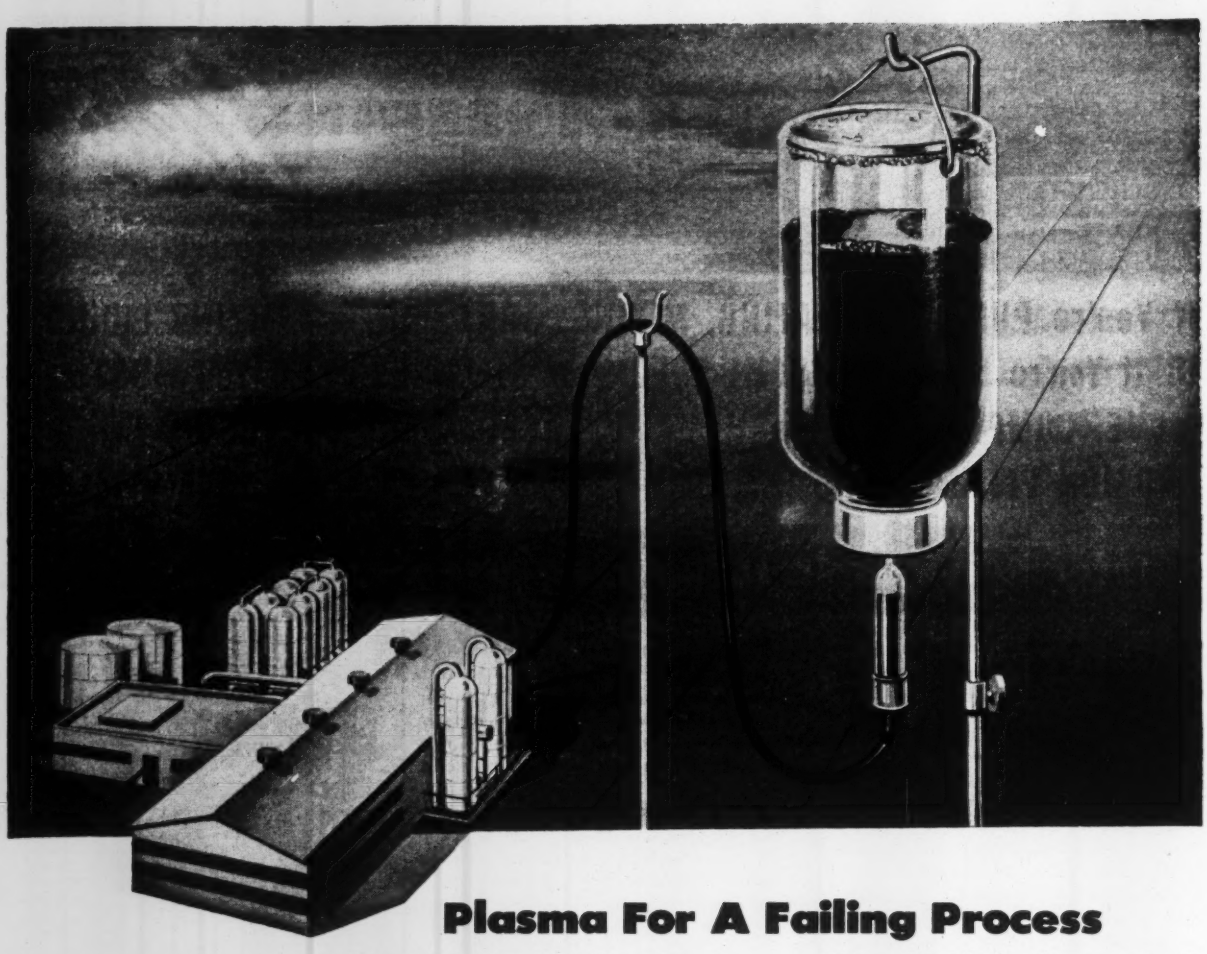
Generally speaking SK Jet Apparatus includes all types and sizes of the equipment listed below, for which information is available. If you want literature on any particular type, use the coupon below. We'll be glad to supply it.



PLEASE SEND ME INFORMATION ON THE FOLLOWING:

- Steam Jet Syphons and Evacuators (2-A) ☐
- Water Jet Eductors, Agitators, Evacuators, Mixers (2-M) ☐
- Steam Jet Heaters for Liquids, Gas Holder Heaters and Sparger Nozzles (3-A) ☐
- Steam Jet Blowers and Blast Nozzles (4-AB) ☐
- Steam Jet Exhausters and Primers, Compressors and Agitators (4-E) ☐
- Steam Jet Thermo-Compressors, Gas Jet Compressors (4-F) ☐
- Water Jet Exhausters and Primers (4-P) ☐
- Fume Scrubbers (4-R) ☐
- Low Level Multi-Jet Condensers (5-A) ☐
- Barometric Multi-Jet and Spray Condensers (5-AA) ☐
- Low Level Eductor Condensers (5-B) ☐
- Steam Jet High Vacuum Pumps and Apparatus (5-EH) ☐
- Spray Nozzles and Systems (6-A) ☐
- Desuperheaters (6-D) ☐
- Everdur Valves and Fittings (7-E) ☐

SCHUTTE and KOERTING Company
Manufacturing Engineers
7 STATE ROAD
CORNWELLS HEIGHTS
BUCKS COUNTY, PA.
Representatives in Principal Cities



Plasma For A Failing Process

Throughput usually suffers when any part of your process gets too weak to keep up with the rest of your system. Here's how one company we know prevented such a problem.

Chlorinated hydrocarbons for use in plastics had to be weighed. Test-tube accuracy without metallic pick-up, contamination or discoloration was essential. Stability had to be maintained with sub-zero temperatures.

The answer: jacketed weigh tanks on suspended scales. Passage between shells gave ample circulation for coolant, while a nickel-clad steel inner shell assured purity... fast, uniform heat transfer. Other results: easy low-cost maintenance, long life.

Where did this solution come from? It was the result of cooperative development between the engineering staffs of progressive Equipment Builders, process engineers and materials suppliers. In developing such equipment, these *better* builders regularly turn to Lukens for its knowledge of materials, as well as its wide range of low-cost clad steels.

Even with new equipment hard to get, these builders can often recondition what you have for better, more profitable production. For their names, write us today, explaining your problem. Manager, Marketing Service, 402 Lukens Building, Coatesville, Pennsylvania.

LUKENS

World's Leading Producer of

SPECIALTY STEEL PLATE · PLATE SHAPES · HEADS · CLAD STEELS

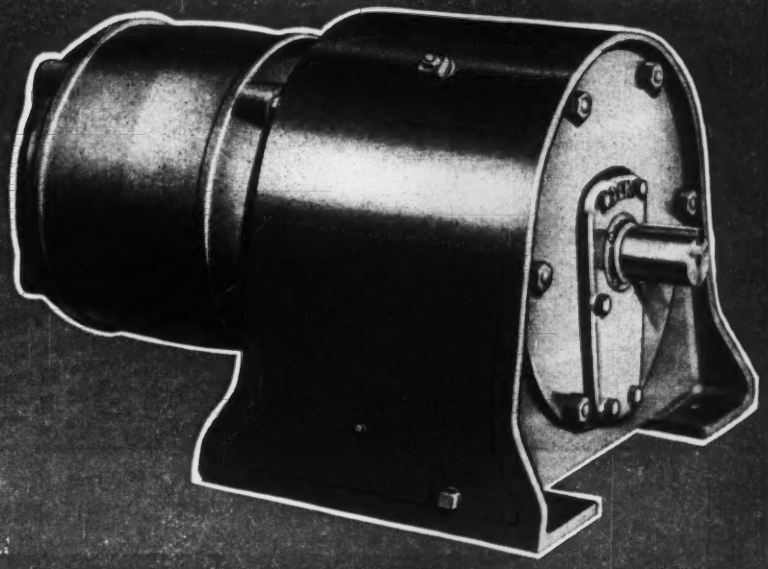
LUKENS STEEL COMPANY, COATESVILLE, PA.

Announcing the *–Newly Designed–* Integral

ALL-STEEL FALK Motoreducer

(Gearmotor Type–Supplementing Falk All-Motor Line)

. . . with completely standard round-frame, D-flange motor

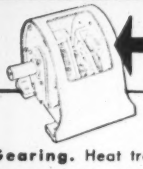


Check and Compare these features...

Meet a faithful old friend in a new, modern dress! The famous, time-proved Integral Type *all-steel* FALK Motoreducer (Supplementing Falk All-Motor Line) has been redesigned into a compact, streamlined unit providing the utmost in space economy—but retaining all the application versatility, long-life performance, easy-maintenance features and superior structural qualities that have made Falk Motoreducers the recognized standard throughout industry.

In this new Integral unit—rated in accordance with AGMA Standards—a *completely standard* round-frame, D flange NEMA motor is mounted directly on the all-steel Motoreducer housing. The motor remains a separate piece of equipment. Size and arrangement of the standard housing permit widest ratio range—from 3.36:1 to 542:1.

In order to meet the widely diversified needs of those who manufacture industrial equipment, the newly designed Integral Motoreducers are available in horizontal and vertical models, both in concentric and right-angle types; double, triple and quadruple reduction; horsepower range, 1 to 40 HP. Prompt stock shipment in standard ratios is offered. Write for Bulletin 3104.



Every FALK Motoreducer has these "In-built" Factors—

Precision Gearing. Heat treated alloy steel, precision cut and shaved helical gearing throughout . . . quiet-operating crown shaved pinions . . . taper bored gears for easy ratio changes.

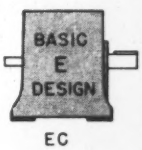
All-steel Housings. Unbreakable, strong, rigid. Generous overhung load capacities provided by wide bearing spans, large shafts and bearings.

Streamlined inside and outside. Smooth, clean surfaces; machine welded construction conforms to NEMA motor frames.

Positive Lubrication. Large sump capacity . . . oil-tight construction assures clean lubricant . . . direct dip of revolving elements provides positive lubrication at all speeds.

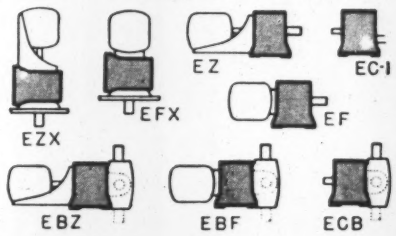
Wide Speed Range. Selective ratio combinations provide output speeds from 1.5 rpm to 1430 rpm with stock gears.

Sealed Housings. Dual closures and one-way vents keep oil *in*, dust and moisture *out*. Units are splash-proof, leakproof, dustproof.



EC

The basic E design permits maximum use of standardized parts . . . closer control over materials, processing, inspection and assembly . . . resulting in faster delivery from interchangeable stocked assemblies.



FALK ...a good name in industry

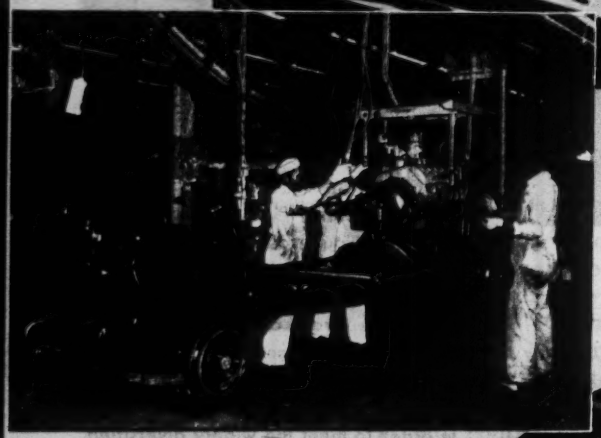
THE FALK CORPORATION · 3001 W. Canal St. · Milwaukee 8, Wis.

WRITE FOR BULLETIN 3104

FORD'S *Most Modern*

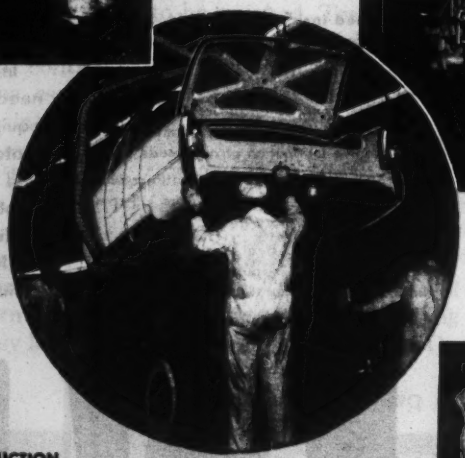
Above workers in **Cushion Department**

Length of Plant is 1500 feet. Width is 900 feet.



Chassis Line or sometimes called the "Build-up" is the portion of the Assembly Line where the completed engine, brakes, springs and many other items are assembled to the frame.

Motor Line is an example of team work in action. Shown above are three men working on the same engine. One is installing the wiring while the other two are attaching an automatic transmission.



Body Drop (right) is where two assembly lines meet. A trimmed body is lowered on a chassis and becomes the Final Line.

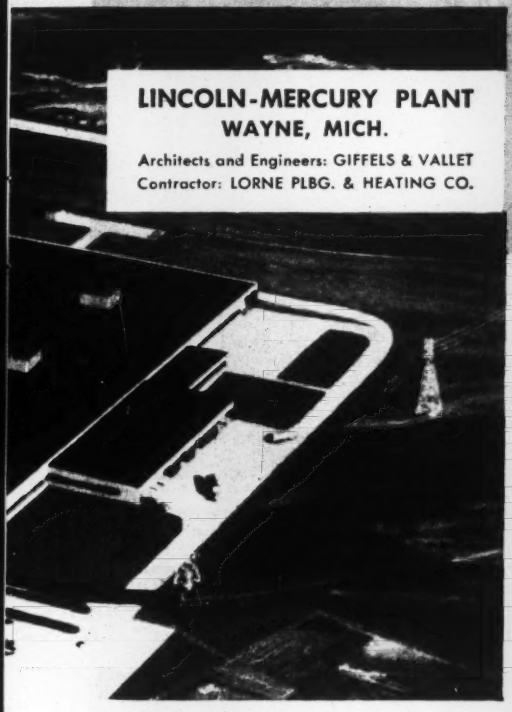
Comfort of employees in the modern **Cafeterias** is assurred by *Powers Control*

POWERS CONTROL

- INCREASES PRODUCTION
- IMPROVES MANY PRODUCTS
- INCREASES OUTPUT OF EMPLOYEES
- REDUCES HEATING COSTS

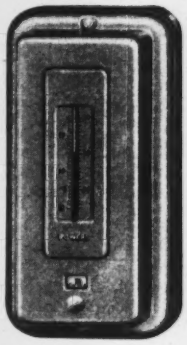
Auto Assembly Plant Equipped with a

POWERS Pneumatic System of TEMPERATURE CONTROL



LINCOLN-MERCURY PLANT
WAYNE, MICH.
Architects and Engineers: GIFFELS & VALLET
Contractor: LORNE PLBG. & HEATING CO.

Comfortable, Even Heat at the Right Temperature for each department helps improve efficiency of employees and results in



- **Increased Production**
- **Better Products**
- **Lower Heating Costs**

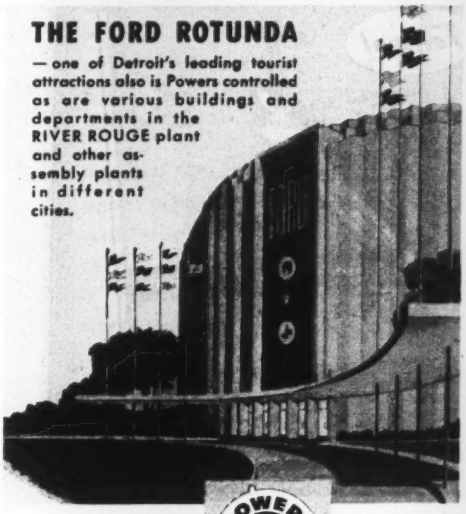
—these are some of the year after year dividends THE FORD MOTOR CO. will receive from its investment in Powers control.

With its almost 1,500,000 square feet of floor space, nine miles of conveyor lines and many advanced features this ultra modern LINCOLN-MERCURY plant is the last word in efficiency. It is a show place among assembly plants.

Into its receiving docks come some 4800 separate parts (with an entire engine as one part). Out of its delivery door, at the rate of 300 cars per 8 hr. day, go completed automobiles tested, checked and ready for driving.

Here a Powers pneumatic control system regulates the steam heating used in the assembly and manufacturing areas and the conditioned air in the paint spray department, first aid and hospital room, cafeterias and administrative offices.

Experience gained by Powers here and in many other important large and small buildings may be helpful to you. When problems of temperature or humidity control arise, contact our nearest office. There's no obligation.

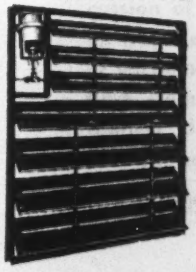


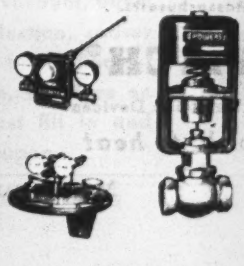
THE FORD ROTUNDA
— one of Detroit's leading tourist attractions also is Powers controlled as are various buildings and departments in the RIVER ROUGE plant and other assembly plants in different cities.

THE POWERS REGULATOR CO.

Since 1891 SKOKIE, ILLINOIS • Offices in Over 50 Cities • See Your Phone Book

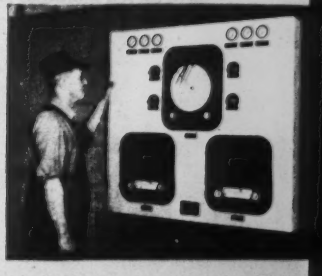
'53 (b27)





POWERS **PACKLESS** VALVES

. . . eliminate packing maintenance, leakage of water or steam, or loss of vacuum.



How would YOU solve these two problems?

1. STORING BULKY FILES. Engineers examine one of 90 compact microfilm rolls that reduce 70,000 drawings, each about 6 square feet in area, for space-saving storage. In a process developed by the Diebold Manufacturing Co. for continuous developing of microfilm, rigid temperature control is essential in the "fixing" tank. Fenwal THERMOSWITCH® unit keeps the "fixing" solution constantly within one degree of the required 100°F.

Photo courtesy of Hotel Statler, Boston

2. KEEPING DISHES SPOTLESS. For this full-time restaurant job, the Statler Hotels and other leading firms serving the public use Colt Autosan Dishwashing Machines. Fenwal THERMOSWITCH devices in these machines have two functions. The first is to control temperature of washing water. Other units act as low temperature cut-off switches — stopping the conveyor belt if water becomes too cold.

3. A FENWAL THERMOSWITCH CONTROL may solve your problems, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of otherwise costly problems.

4. SEND FOR THIS CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. **Write Fenwal Incorporated, 511 Pleasant Street, Ashland, Massachusetts.**

Fenwal

THERMOSWITCH®

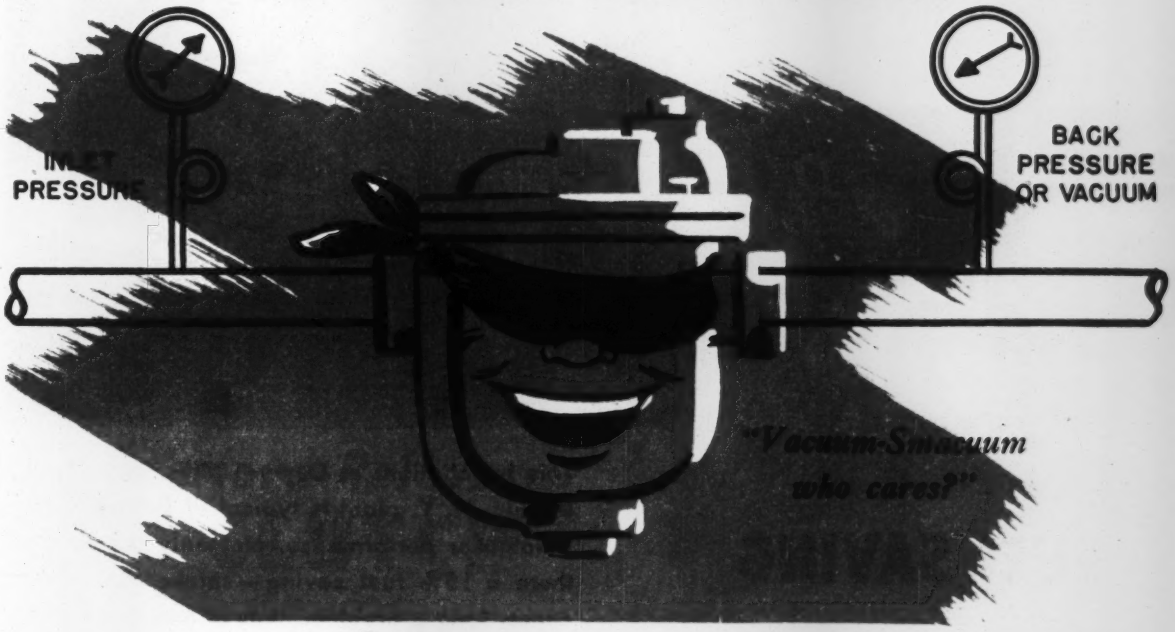
Electric Temperature Control and Detection Devices

SENSITIVE...*but only to heat*

VACUUM ISN'T VACUUM

TO A STEAM TRAP

. . . It's Just Pressure Below Atmospheric



ONLY 2½¢ per year per trap parts costs on traps averaging 11 years of service at Globe Steel Tubes Company, Milwaukee, Wisconsin.

PRACTICALLY ZERO maintenance, complete satisfaction with traps after 12 years service on 10 lbs. pressure, 5" vacuum—Liquid Veneer Corp., Buffalo, N.Y.

BUYERS are sometimes told that steam traps for vacuum return service must be "different"—requiring, we suppose, some mysterious ability to recognize vacuum and act accordingly.

The truth is that vacuum isn't vacuum to any steam trap. It is just pressure below atmospheric pressure. All vacuum does is increase the pressure differential across the trap orifice. An Armstrong trap doesn't care whether it discharges to vacuum, back pressure or atmosphere. It works just the same in all cases.

Because Armstrong traps don't have to wait for condensate to cool, drainage is fast and equipment temperatures and BTU output are maximum.

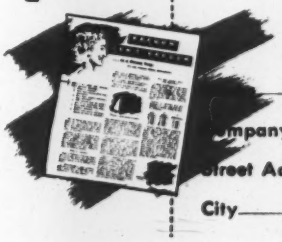
Armstrong traps won't cause you to lose vacuum. Any flash steam from their discharge is quickly condensed. *It is the leaky traps that make it hard to hold vacuum!*

The mechanisms in Armstrong traps for low pressure vacuum return service are identical in design, workmanship and materials to those used in traps for 900°F, 950 lbs. pressure. They can't help but operate a long, long time without leaking. This makes it nice for the maintenance man, too.

Fast heat-up, high temperatures, low maintenance, long life—all wrapped up in one package. Ask your Armstrong Representative to go over your vacuum heating system with you.

ARMSTRONG MACHINE WORKS
894 Maple St., Three Rivers, Michigan

***Send for 4-page Bulletin No. 223, "Vacuum Isn't Vacuum"—a complete discussion of vacuum, effect on trap selection, causes of vacuum loss, effect of flash steam, etc. Free on request. Just fill in and mail the coupon.**



ARMSTRONG MACHINE WORKS
894 Maple St., Three Rivers, Michigan
Please send Bulletin 223, "Vacuum Isn't Vacuum"

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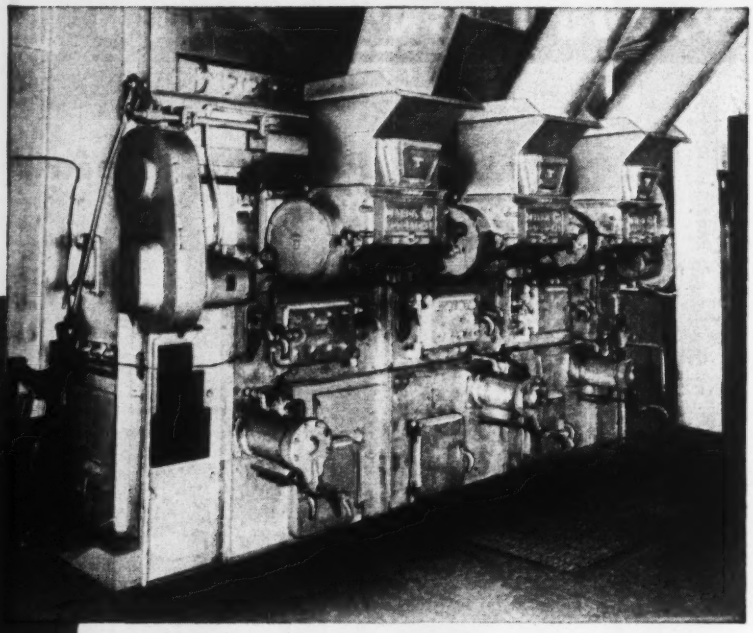
15% FUEL SAVING

with a

NEW DETROIT ROTOSTOKER FIRED BOILER



This installation, at General Mills, Inc., Buffalo, N. Y. plant is typical of Detroit RotoStoker performance. Not only was there a 15% fuel saving—smoke nuisance, long a problem, was eliminated.

Detroit RotoStokers burn economically any Bituminous Coal or Lignite without special preparation. They increase boiler capacity and respond quickly to sudden changes in load. Fuel is fed by efficient Overthrow Rotors. Fine fuel is burned in suspension—coarser fuel on the grates with uniform, but comparatively thin fuel bed.

Hundreds of Detroit RotoStokers are successfully applied to all makes and types of boilers or steam generators.

Do you need more steam at lower cost? If so, investigate the RotoStoker. Write for Catalog.

6215

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MAXITORQ

Overload Release CLUTCH

minimizes machine Down-Time

AT THE
GILLETTE SAFETY RAZOR CO.

The Maxitorq automatic Overload Release Clutch was designed especially to protect high-speed machinery, and we are gratified to have testimonials such as the following:

> "The Gillette Safety Razor Company chose the Maxitorq Overload Release Clutch to protect a section of their blade and shaving cream packaging machines against costly down-time due to unpredictable machine jams.
>
> "Over a period of a year, wrapping millions of blades per week, Maxitorq Clutches have eliminated machine down-time except in a few minor instances. Thus, more constant production has been maintained in the packaging department."

When an accidental overload occurs, the clutch automatically releases, stopping the machine, preventing damage to machine and product. When the jammed condition has been cleared, the clutch is re-engaged and the machine is again in operation. By means of a simple finger-tip adjustment, the clutch is set to transmit the normal running load.

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8CJ53

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Philadelphia Spiral-Bevel Cooling Tower Units are manufactured in five sizes, rated from 15 to 60 Horsepower at 1750 rpm motor speed.

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Zurn Low Pressure Drop (LPD) Strainers are design improved for correct circularity. They have ample waterways; smooth inner walls; correctly sized and perforated baskets, eccentrically positioned, all of which combine to reduce pressure loss and afford maximum protection for all types of mechanical units connected with pipe lines. Zurn LPD Strainers are held to close tolerances for materials, shapes, and dimensions, assuring the utmost in strength and safety and continuous operation.

Zurn LPD Strainers are widely used to protect close-tolerance control devices and delicate mechanisms, also to protect product purity. They make continuous production processes possible.

Zurn LPD Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants; ships and high-temperature installations. Zurn Fluid Handling Engineers are available for consultation on your particular problem.

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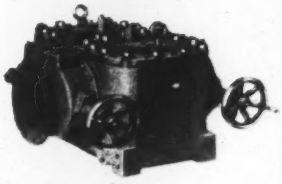
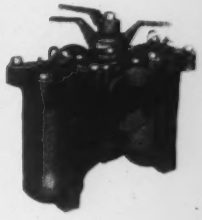
There is a ZURN LPD strainer for every fluid handling purpose



Zurn Duplex Gate Type Multi-Basket Strainer.

Zurn Sinlex Strainer. Available in offset and straight-through types.

Zurn "Y" Type Strainers available in any cast material and for high pressures.



Zurn Duplex Plug Type Strainer.

Zurn Engineered Low Pressure Drop Strainers are patented and patents pending.

WRITE FOR LPD STRAINER MANUAL DATA NO. 952

This manual includes previously unpublished pressure drop data and gives useful, factual information on fluid handling.

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J. A. ZURN MFG. CO.
Industrial Division, Erie, Pa., U. S. A.
Please send me Zurn LPD Strainer Manual Data No. 952.

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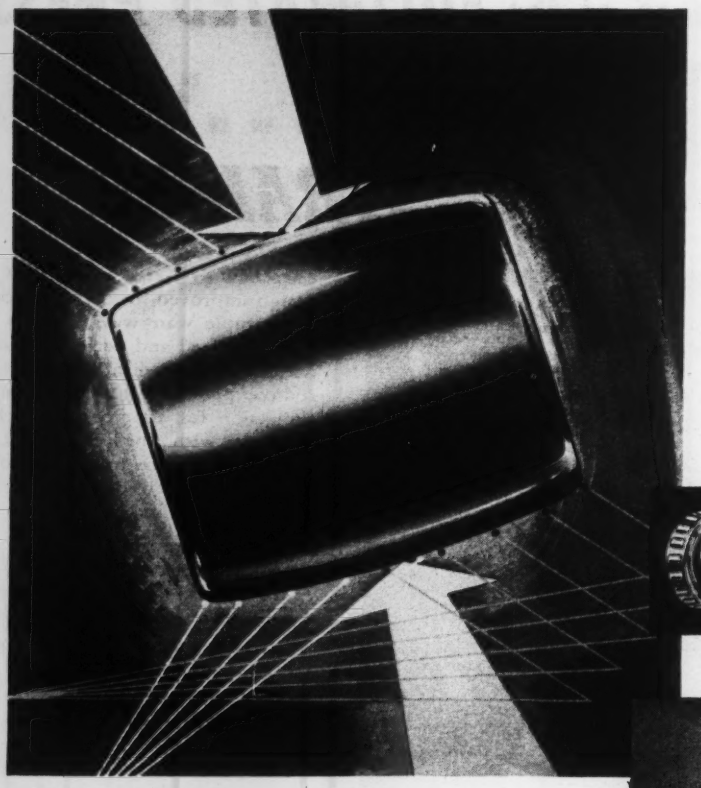
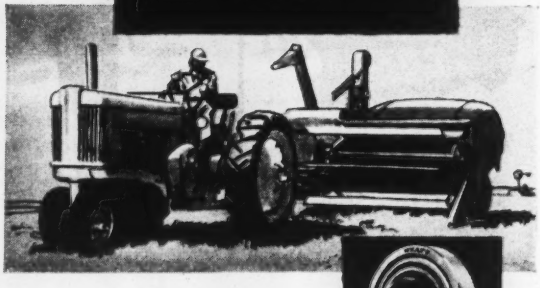
Please attach coupon to your business letterhead—Department A-53.





A new era in bearings is taking this shape...

NEW HYATT BARREL BEARING

now available in volume!

Industrial designers and engineers seldom make changes in bearing specifications. But when they discover something *really new*—like Hyatt's BARREL BEARING—out come the blueprints! *And this time they know they've got something!* Hyatt's new Barrel Bearing combines dual-purpose design with self-aligning action. It takes load from any direction and operates at full efficiency under conditions of misalignment! And, because barrel-shaped rollers provide high load capacity with low friction, this unique bearing is ideal for a wide range of applications. Best of all, the *cost* is far lower than you would expect! Find out how to improve *your* product . . . Consult a Hyatt Sales-Engineer, or write for our new Barrel Bearing catalog.

HYATT ROLLER BEARINGS

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION, HARRISON, N. J.

Easier pneumatic operation boosts crane output 33%

Air is now used to operate the throttle and clutches of this 50-ton locomotive crane. As a result, scrap metal, iron ore, and freight are handled faster at the Port Covington yard of Western Maryland Railway Co.

Formerly, the operator of this crane had an awkward ceiling-mounted steam throttle valve, 4 clutch levers, and 4 direction levers to manipulate. This jumble of manual controls slowed up operation and reduced the operator's efficiency.

In 1950, this system was vastly improved with Westinghouse Air Brake pneumatic control. Just *one* Controlair® valve replaced the old throttle valve and 4 clutch levers. This new valve is mounted right in front of the operator, always in easy reach. He accurately controls speed and clutching with *one movement of one hand.* This easier control doesn't tire him out . . . keeps him alert and at peak efficiency all day . . . enables him to move ⅓ more material a day.

Westinghouse Air Brake Co. supplied the complete pneumatic system for this crane, from control valves to air compressor. It has worked 8 hours a day, 6 days a week since February, 1950, and has given no trouble.

Westinghouse pneumatic controls can do a comparable job on your equipment. For complete information, write to Westinghouse Air Brake Co., Industrial Products Division, Wilmerding, Pa.

Daily tonnage was increased 1/3 on this 50-ton locomotive crane with a new Westinghouse Air Brake pneumatic system. Westinghouse controls simplify operation and reduce operator fatigue.

This Westinghouse Controlair® valve takes the place of one steam throttle valve and 4 clutch levers. It saves time and increases productivity of the crane.

Westinghouse Air Brake
COMPANY

INDUSTRIAL PRODUCTS DIVISION WILMERDING, PENNSYLVANIA

Factory Branch: Emeryville, Calif. In Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario

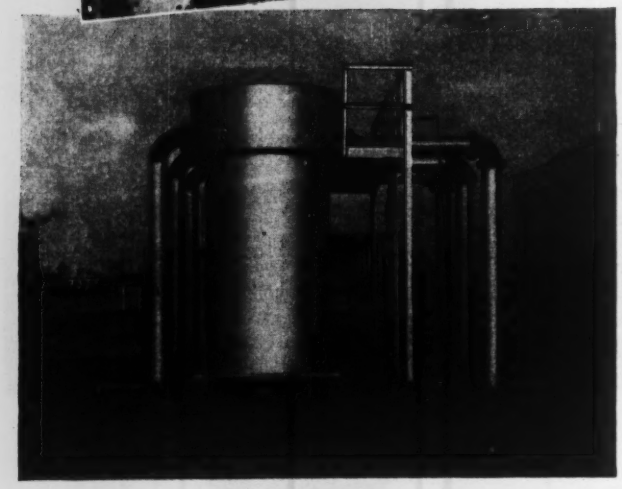
Dirty Water can't "Shut-down"...

Vogt

film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

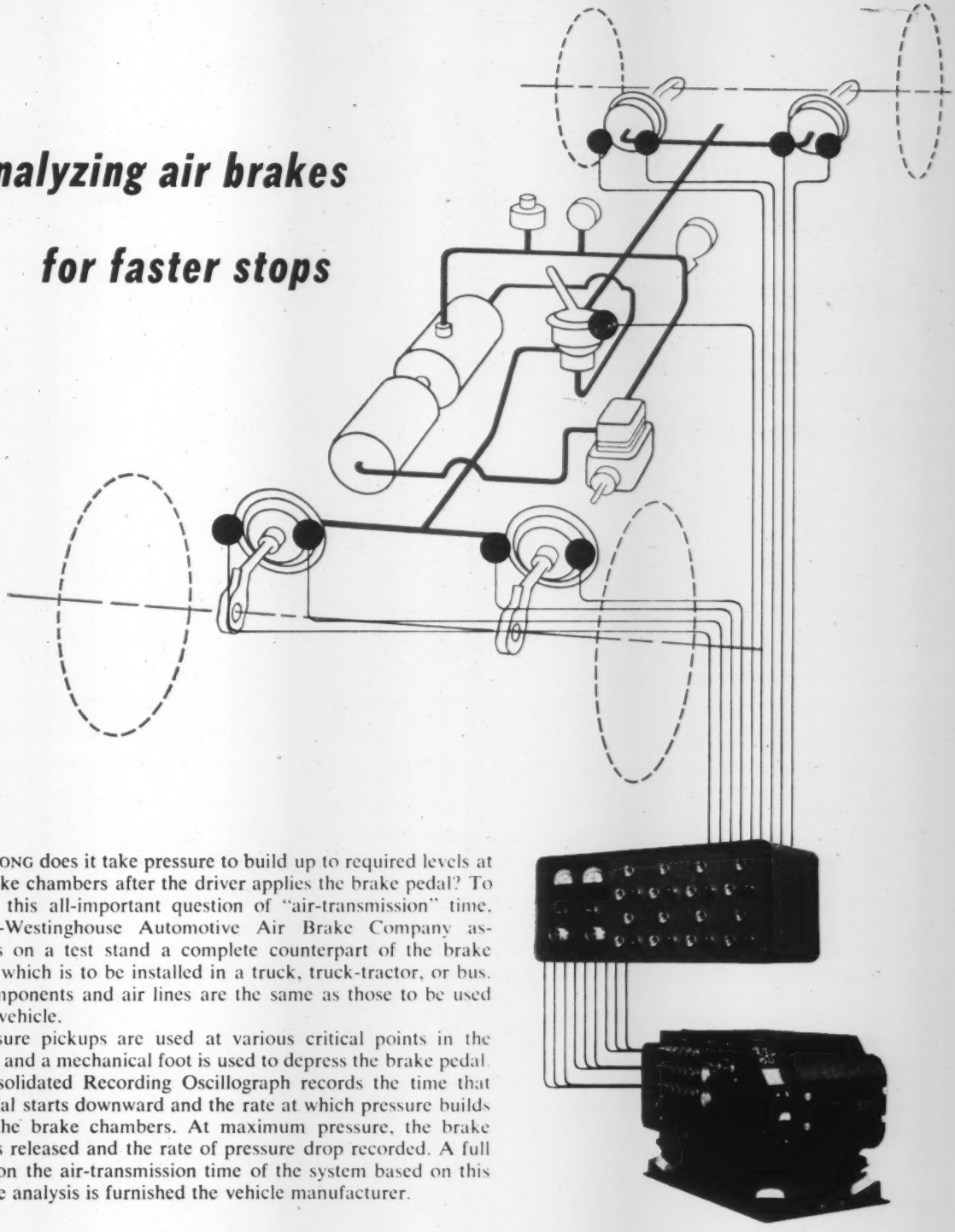
BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Analyzing air brakes for faster stops



HOW LONG does it take pressure to build up to required levels at the brake chambers after the driver applies the brake pedal? To answer this all-important question of "air-transmission" time, Bendix-Westinghouse Automotive Air Brake Company assembles on a test stand a complete counterpart of the brake system which is to be installed in a truck, truck-tractor, or bus. All components and air lines are the same as those to be used on the vehicle.

Pressure pickups are used at various critical points in the system, and a mechanical foot is used to depress the brake pedal. A Consolidated Recording Oscillograph records the time that the pedal starts downward and the rate at which pressure builds up at the brake chambers. At maximum pressure, the brake pedal is released and the rate of pressure drop recorded. A full report on the air-transmission time of the system based on this accurate analysis is furnished the vehicle manufacturer.

Consolidated Engineering
CORPORATION
300 North Sierra Madre Villa, Pasadena 8, California

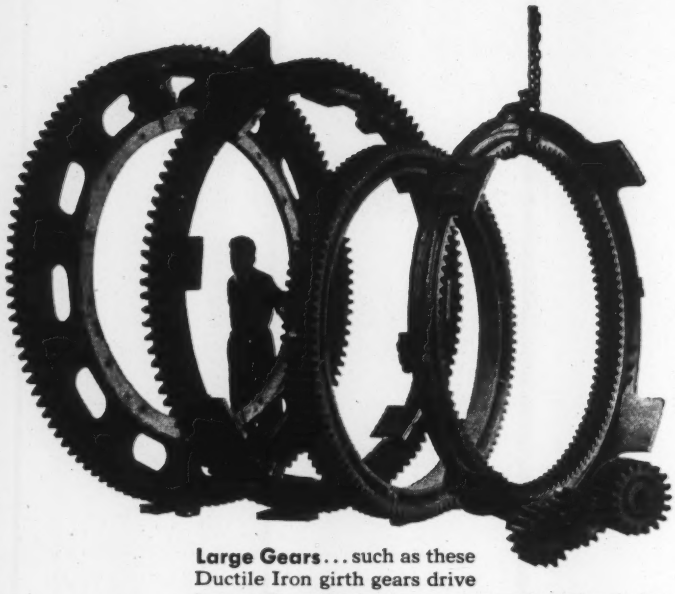
Sales and Service through **CEC INSTRUMENTS, INC.,** *a subsidiary with offices in: Pasadena, New York, Chicago, Washington D C., Philadelphia, Dayton.*

analytical instruments for science and industry

Dynamic Recording Systems

. . . like the one shown here are designed and manufactured by Consolidated. Variations in the arrangement of the equipment are infinite. Applications are widely varied throughout industry and the sciences. A typical recording system includes pickups, amplifiers or bridge balances, and a recording oscillograph. Write for Bulletin CEC 1500B.

DUCTILE IRON GEARS provide *Superior Strength* with *Excellent Resistance to Wear*



Large Gears... such as these Ductile Iron girth gears drive large tube mills in the cement and mining industries. Put into service without heat treatment, they normally provide 92,000 to 100,000 psi ultimate tensile strength, 3 to 5% elongation, and 270-290 BHN on the tooth surface.

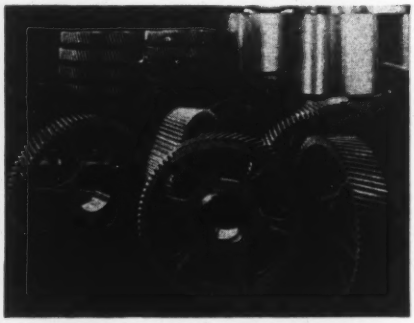
In addition to excellent castability, ready machinability and moderate cost, Ductile Iron offers properties that are vital in a gear material.

For along with high strength and measurable ductility, Ductile Iron "as cast" combines good resistance to wear and galling, with superior values for notched endurance limits.

Ductile Iron can be heat treated to provide tensile strengths of over 150,000 psi. It develops surface hardnesses of over 600 BHN after flame or induction hardening. Service data show also that annealed Ductile Iron develops impressive properties which result in peak performance.

Ductile Iron can provide a chilled, carbidic, abrasion-resistant surface supported by a tough ductile core. No other single material combines these properties. Still another advantage is its ability to damp out vibrations that otherwise might build up stresses to dangerous levels.

Send us details of your prospective uses, so that we may suggest a source of supply from some 100 authorized foundries now producing Ductile Iron under patent licenses. Request a list of available publications on Ductile Iron ... mail the coupon now.



Medium Gears produced in heat treated Ductile Iron have replaced steel gear castings and forgings in papermaking and allied equipment. Annealed Ductile Iron can be machined at a rate of 2 to 3 times that of good quality gray iron of comparable hardness.

The International Nickel Company, Inc.
Dept. 20, 67 Wall Street, New York 5, N. Y.

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ME-11-53

Please send me a list of publications on: **DUCTILE IRON**

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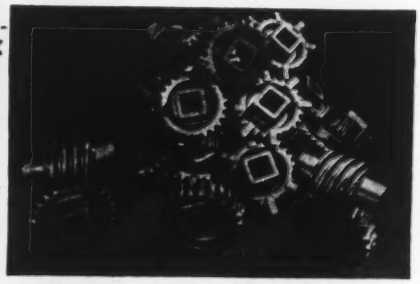

Small Gears ... also worms ... exemplify an application of Ductile Iron in the railroad field.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET
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MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 75 NUMBER 11

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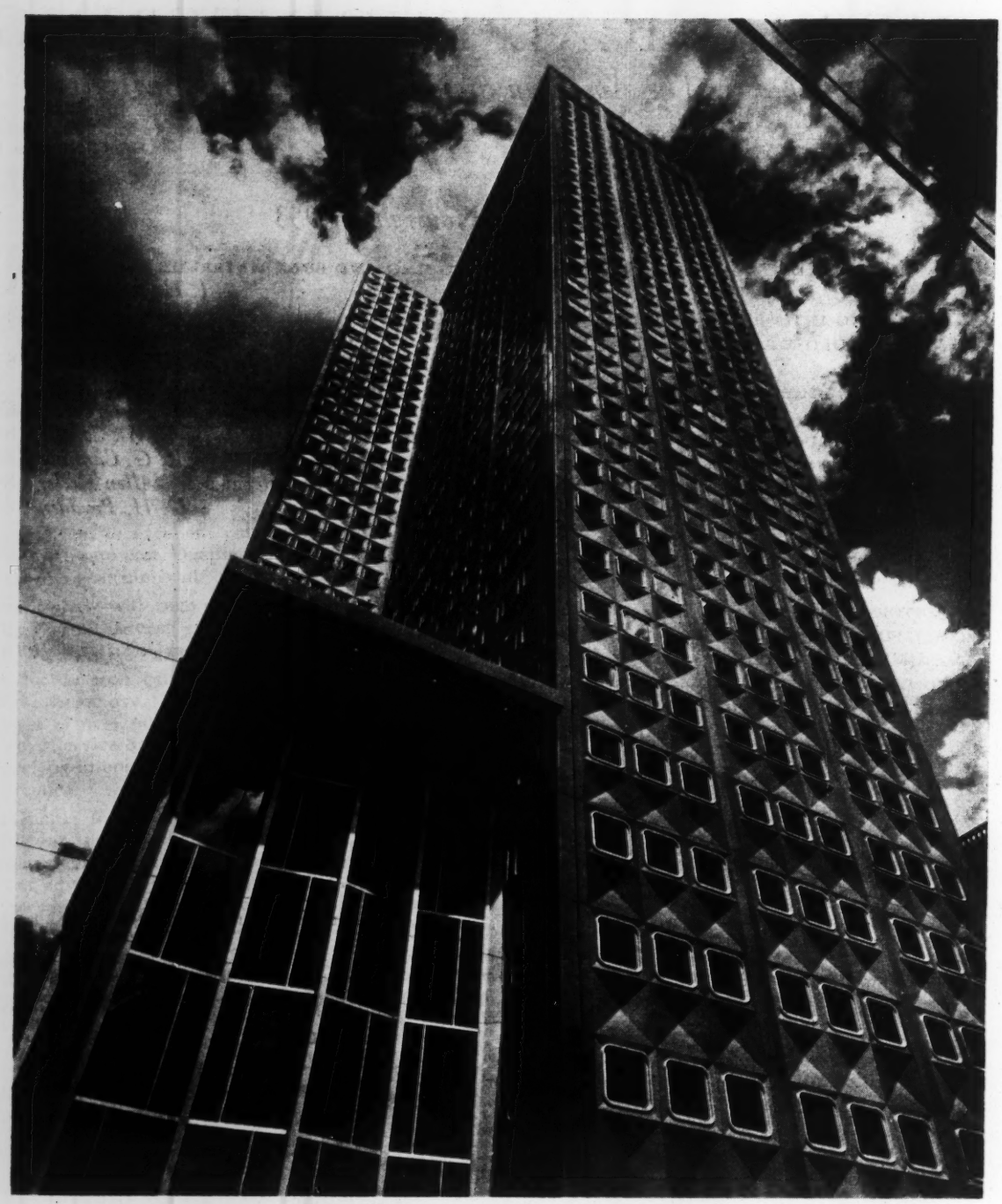

Aluminum Skyscraper

(Alcoa Building Pittsburgh, Pa., newly erected 410-ft, 30-story structure, built by Aluminum Company of America; it is said to be the lightest building for its size ever built. Further details may be found on pages 906–908 of this issue.)

VOLUME 75
No. 11

MECHANICAL ENGINEERING

NOVEMBER
1953

GEORGE A. STETSON, *Editor*

How a Paper Comes to Be

ONE of our readers has asked "how an ASME paper comes to be." Presumably what he desires is an explanation of the procedures that are followed from the time a paper is solicited or submitted until it is published. The procedure is set forth in a pamphlet, "An ASME Paper, Its Preparation, Submission and Presentation, and Publication." This pamphlet was designed to meet the needs of persons who contemplate submission of a technical paper to The American Society of Mechanical Engineers, and to them it is, or should be, very useful. But it is not a satisfactory reply to our reader.

Any comprehensive statement about ASME papers must begin with meetings and program making and end with publication. The Society holds four national meetings each year—Spring, Semi-Annual, Fall, and Annual, with meeting places chosen so as to follow a pattern designed to insure a reasonably satisfactory geographic distribution. Several professional divisions supplement these national meetings with national division conferences. From Oct. 1, 1951, to Sept. 30, 1952, there were 415 papers presented at the four national meetings and 143 at the six division conferences. These 558 papers constitute the bulk of the ASME papers of that year. Of the papers presented at the 917 meetings held during the same period by 86 ASME Sections, only a handful reached the Secretary's office. A few ASME papers came from other Society sources. Hence, for simplification, the term ASME paper will refer to a paper that is presented at an ASME national meeting or at an ASME division conference.

How do papers get on the programs of national meetings and division conferences? Although the Meetings Committee is in general charge of national meetings, the programs of the technical sessions at these meetings are arranged by the Professional Divisions and several technical and other committees. It is convenient to speak of these groups as program-making agencies. Division conference programs are arranged by the divisions holding the conferences. Whether it be a national meeting or a division conference, the procedures followed by the program-making agencies in respect to ASME papers are approximately the same. The division or committee which assumes responsibility for a session at a meeting or conference decides what papers are to be presented.

How do divisions and committees get the papers they schedule for presentation? There are two major sources of papers, "invited" and "contributed" papers. In the planning of technical sessions, it is customary for a program-making agency to select a theme or subject. Authorities on the subject or some phase of it are then invited to prepare papers for the session in question. On the other hand, an author may take the initiative himself and submit to the Society, or to one of its professional divisions or committees, a paper he has prepared for discussion and publication. This is known as a contributed paper. When a contributed paper is sent to the Secretary or the editor, it is acknowledged and referred to whatever division or committee is most likely to be interested in it. Thus the program-making agencies may have their stock of papers enriched by papers not contemplated in their program planning. Sometimes these contributed papers fit into sessions already in the planning stage. Sometimes additional sessions are planned to accommodate the contributed papers.

How are papers handled after authors have submitted them? All technical papers, invited as well as contributed, are reviewed by a division or a committee before they are scheduled for presentation or publication. A few invited papers are scheduled for presentation on the basis of a digest prepared by the author, but all such papers pass through the reviewing procedure before they are considered for publication. The review of an ASME paper, whether it be a paper for presentation at a meeting or for publication, is an important factor in maintaining high standards of quality. Review procedures are more formal and thorough in some divisions than in others. Some divisions have a review committee which is independent of the program-planning committee. In other divisions every member of the executive committee reviews all papers. Another scheme is to make one man responsible for review and to give him authority to select such reviewers as may be necessary.

What is done with reviewers' reports? Comments by reviewers are, of course, confidential. If errors are noted in an otherwise acceptable paper, if condensation is desired, if additional material, text, or illustrations seem necessary, if obscure statements demand clarification, the author is given an opportunity to revise his paper on the basis of comments and suggestions received. The accepted paper is then scheduled for presentation and the author is notified. The manuscript, illustrations, recommendation forms, and any pertinent instructions are sent to the Secretary's office.

In parallel with all of the planning and dealings with authors that are being carried on by the program-making agencies, the Secretary's office is busy with a multitude of arrangements and preparations. ASME meetings have a reputation for running smoothly and being well planned and the Society has always believed that the discussion of a paper is important. From the earliest

days, when the Council itself read, accepted, and scheduled every paper, it has been Society policy to provide preprints of papers to be presented at meetings. In fact, this magazine was started not only as a means of informing members about Society affairs but also to get advance copies of papers into the hands of members before presentation at meetings. With the growth of membership and the number of papers presented, MECHANICAL ENGINEERING can no longer be used for this purpose. However, it is used to announce the programs of coming meetings and to notify members of the availability of preprints.

Now let's work back and see how the foregoing factors affect the time element in planning meetings. The current Annual Meeting was scheduled several years ago for the first week of December, 1953. If discussers are to have time to read the papers they are interested in and prepare discussion, the last preprint should be ready for mailing on November 1. If they are to know what papers are to be presented, the program must be announced in the October issue of MECHANICAL ENGINEERING. The Society should not announce papers that have not been reviewed and preprinted. Hence the date for receipt of manuscripts at the Secretary's office is backed up to August 1. The review procedures take time, at least another month. And because a technical paper cannot be dashed off overnight, most Annual Meeting papers would have to be written sometime during the spring season, and hence the program planning of the division or committee is backed up about a year prior to the date of the meeting. Meetings just don't happen; they have to be planned. And hundreds of people, busy and loyal members spending their time and energy freely for the benefit of their fellows, in addition to the authors and the Secretary's staff, are involved.

But to get back to the paper itself. It has been written, reviewed, possibly revised, and sent to the Secretary's office as a manuscript ready for editing with illustrations that can be reproduced. With it comes a form on which the division or committee recommends to the Publications Committee how it should be published. Now the Publications Committee takes over. It alone has authority to assign the paper to the periodical publications—Transactions, *Journal of Applied Mechanics*, and MECHANICAL ENGINEERING. In so far as it is possible to do so, the Publications Committee follows the recommendation it receives, but it makes its own appraisal as well.

If time permits, papers assigned to the periodical publications are preprinted from type. Papers not so assigned, and those assigned but not received in time for the much longer process of printing from type, are multilithed so that preprints will be available for distribution before the meeting. Numbers are assigned to each paper. These numbers are used in the preliminary program and in the digests and order forms that appear in MECHANICAL ENGINEERING and in the final program of the meeting. The first numerals of these numbers signify the year, say 53; the letters indicate the meeting, A for Annual, OGP for Oil and Gas Power Conference, etc; and the final numerals give the serial number of the paper for the meeting in question. Thus an attempt is made to provide preprints of every technical paper presented at national meetings and division conferences. At some division conferences all preprints are packaged. On payment of a registration fee, each registrant gets a complete set of preprints. At other conferences and at all national meetings, registrants purchase whatever copies of papers they desire.

When a paper is printed in the periodical publications, written discussion is also published. Discussion of papers in MECHANICAL ENGINEERING and *Journal of Applied Mechanics* is not published with the original paper but in a later issue. Transactions papers are printed with the discussion appended to them. Some divisions reprint papers after presentation, with discussions appended, and the entire group of papers is issued as the proceedings of the conference. Papers not assigned to the periodical publications or included in the proceedings do not advance beyond the preprint stage and hence discussion on these is not published. All such papers are filed in the Engineering Societies Library, with manuscripts of papers received too late for preprinting. All such preprints and manuscripts are ultimately bound for permanent Library reference. To sum up briefly, all ASME papers of national meetings or division conferences, providing the Society has a copy of the manuscript, are permanently available in the periodical publications or in the volumes of miscellaneous papers bound by the Library, and some may also be found in the proceedings of division conferences. Indexes of the periodical publications and lists of other ASME publications have always been issued in January, and beginning in 1954, titles of the miscellaneous papers bound by the Library will be included.

The foregoing paragraphs refer to technical papers presented at ASME national meetings and division conferences. On almost every program there will be found a number of papers (addresses, lectures, and some technical papers that for one reason or another have failed to keep up with the time schedule) of which no preprints are provided. Some of these are eventually published. Experience shows that of every 100 papers announced on final programs, slightly more than 70 are available in preprint form and about 50 are ultimately printed with discussion in MECHANICAL ENGINEERING, Transactions, and the *Journal of Applied Mechanics*.

It should be evident from the foregoing that an ASME paper comes into being as the result of a long and painstaking process in which many persons and committees are involved. From the planning and writing stages to the printing, distribution, and filing stages, every effort is exerted to maintain high standards of quality and service. The printed word has a dogged permanence. It stands forever as testimony of the reputation of the man who wrote it and as a measure of the skill and judgment of all persons who planned, reviewed, recommended, selected, and handled the mechanical details of putting it into type. At every step of the way all persons concerned must keep in mind not only their obligations to the authors but also their obligations to the members of the Society and to readers of today and the future.

Trend Toward Automation in Automatic Weighing and Bulk Materials Handling

By I. H. RICHARDSON

RICHARDSON SCALE COMPANY, CLIFTON, N. J.

INTRODUCTION

"AUTOMATION" is a word becoming increasingly common in production parlance, and is believed to have originated at the Ford Motor Company. It means, of course, the application of automatic control to production or processing methods to a point where labor is almost if not entirely eliminated. The idea is a laudable one, and as proved in the early "industrial revolution," laborsaving equipment makes work for "labor."

This is not the occasion to dwell on the economic and social consequences of automation, but rather to point out the fact that it is an irresistible trend, and those in manufacturing or processing must recognize it as such if they are to compete with those who do. There is no single authority on the subject beyond a knowledge of what is being done along some specialized line; there is little published to cover the independent progress going on all over the country.

It is the author's intention to avoid a technical discussion of instrumentation whereby automation becomes possible, but instead to point out what has actually been done by specific companies in a variety of industries toward more fully automatic operation. The illustrations deal with bulk materials handling, particularly where automatic weighing and proportioning are involved, and these illustrations are given in chronological order to indicate the trend.

AUTOMATIC WEIGHING AND MATERIALS HANDLING

To provide some background for the case histories, automatic weighing will be described briefly and its application to bulk materials handling will be mentioned.

There are two major classifications in industrial weighing. The first is "postweighing," or the determination of the weight of a given load as accomplished by the conventional track scale, hopper scale with beam or dial, or the simple bathroom scale. Postweighing has no part in this discussion. We are dealing with the second classification of "preweighing" or the automatic delivery of a prescribed quantity of bulk material (or liquid) from an unlimited source of supply. For example:

1 Quaker Oats Company automatically draws flour from a bin and punctuates the stream in quantities of 100 lb, delivering it under packing pressure to paper and textile bags, Fig. 1.

2 Country grain elevators all over the country load out grain to cars and punctuate the stream automatically in fixed quantities, usually 600 lb for 10 bu of wheat, and totalize the weighings to arrive at a carload shipping weight.

3 In Hawaii the sugar mills punctuate automatically their production stream of sugar juice, usually in 3000-lb increments for a capacity of 180-tons hourly, Fig. 2.

4 Owens-Illinois and other glass concerns do the same thing with their aggregate, using one scale for each ingredient like silica, soda ash, limestone, the various scales being interlocked so that none can discharge its preweighed load until all are ready, thus assuring proper formulation at a rate approaching 50 tons of bottles hourly.

These and scores of other applications require automatic scales which differ not only in capacity but according to the materials to be handled. So bulk materials handling enters the picture. This can best be described by illustrating various batch-type automatic scales which differ because of the materials to be handled, the actual weighing operation being only incidental. The materials-handling components basically must include a means of controlled feeding, a weighed receptacle or hopper with means for a controlled discharge.

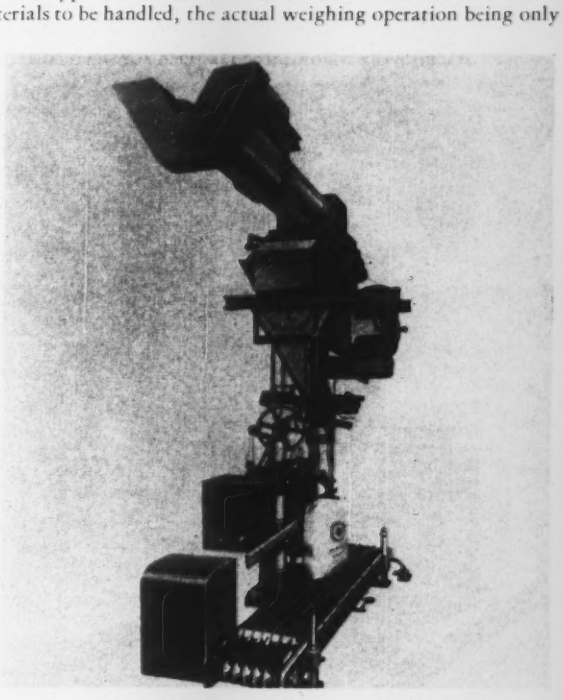

FIG. 1 DELIVERING FLOUR IN 100-LB LOTS UNDER PACKING PRESSURE

TYPES OF SCALES

The simplest of all automatic scales is the automatic grain scale because the materials handling is basically simple, Fig. 3. A radial gate opens to a triggered lock under the pressure of counterweights; grain pours to the weigh hopper until the beam balances and so trips the trigger to close the gate. This me-

Contributed by the Materials Handling Division and presented at the Semi-Annual Meeting, Los Angeles, Calif., June 28-July 2, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

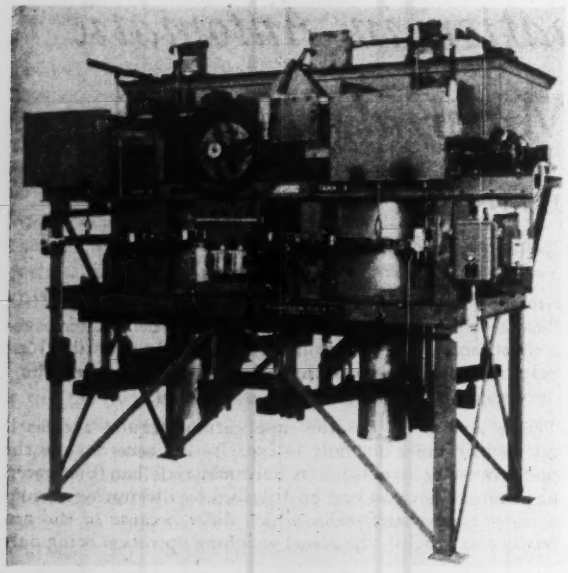

FIG. 2 MACHINE FOR WEIGHING SUGAR JUICE AUTOMATICALLY

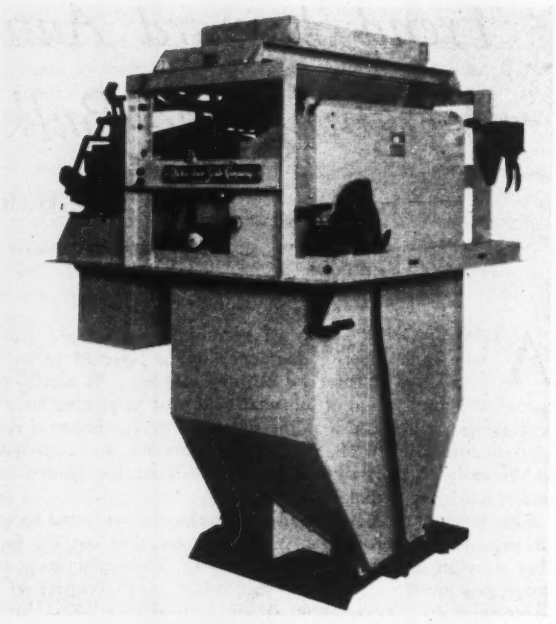

FIG. 3 AUTOMATIC GRAIN SCALE

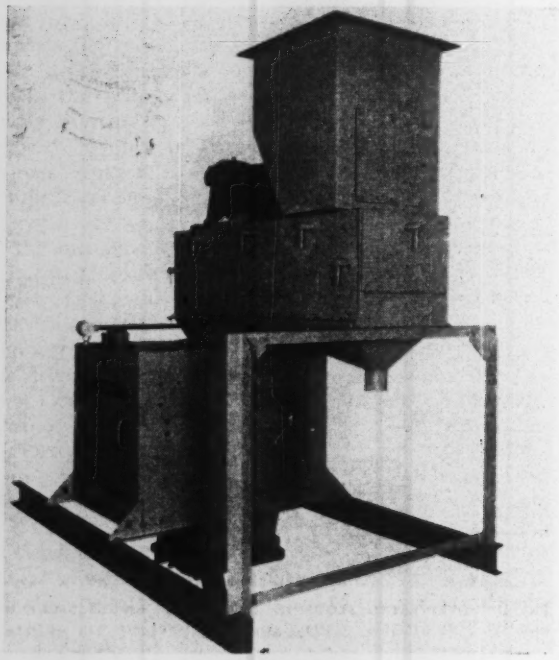

FIG. 4 BELT FEEDER

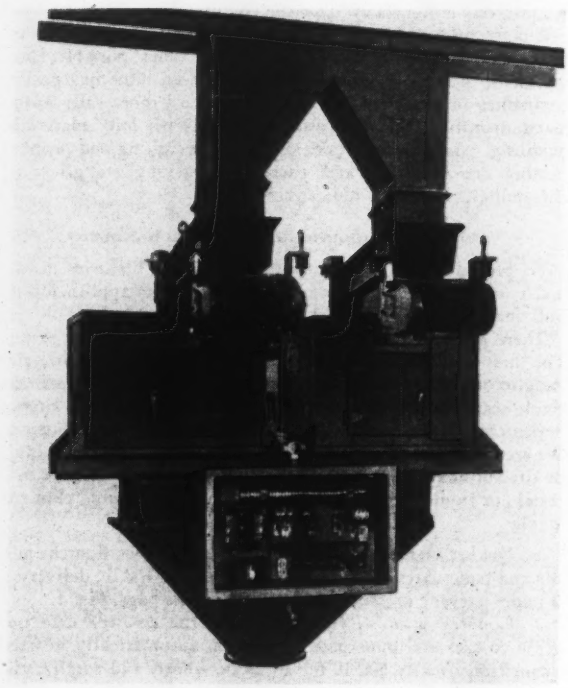

FIG. 5 VIBRATING FEEDER

chanical operation breaks the toggle to release the hinged hopper door, thereby discharging the weighed material. This principle is some 60 years old and is still without equal for simplicity in weighing granular materials accurately to within 1 oz in 100 lb or $^1/_{16}$ of 1 per cent.

However, all materials are not granular. They vary from minus 300-mesh cement (and much finer) to 18-in. lumps of limestone. Materials may be sticky like dairy feed with 30 per cent molasses, or fibrous like asbestos, or hot like cherry-red clinker, or abrasive, corrosive, toxic, explosive, and more recently, radioactive.

As materials become coarser and therefore less free-flowing, the gravity feed is replaced by the belt feeder, Fig. 4, the vibrating feeder, Fig. 5, or the steel apron. As they become finer, feeding control is obtained by the multiple screw, Fig. 6, or

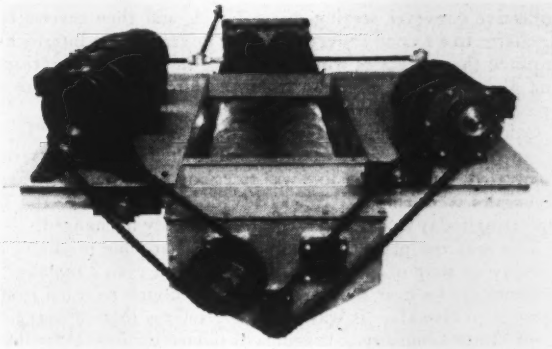

FIG. 6 MULTIPLE-SCREW FEEDER

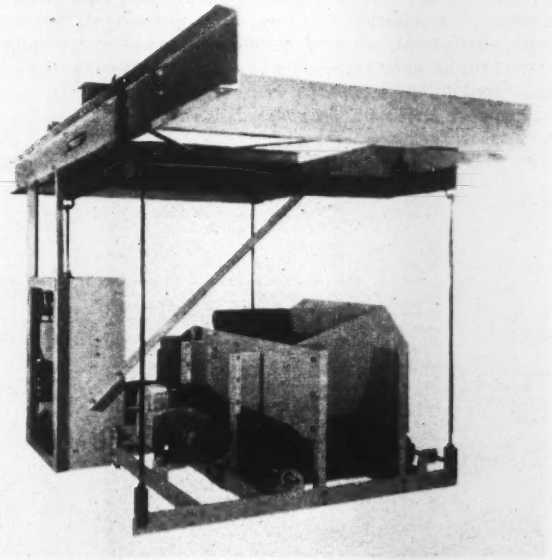

FIG. 8 SYSTEM FEATURING DIFFERENTIAL WEIGHING

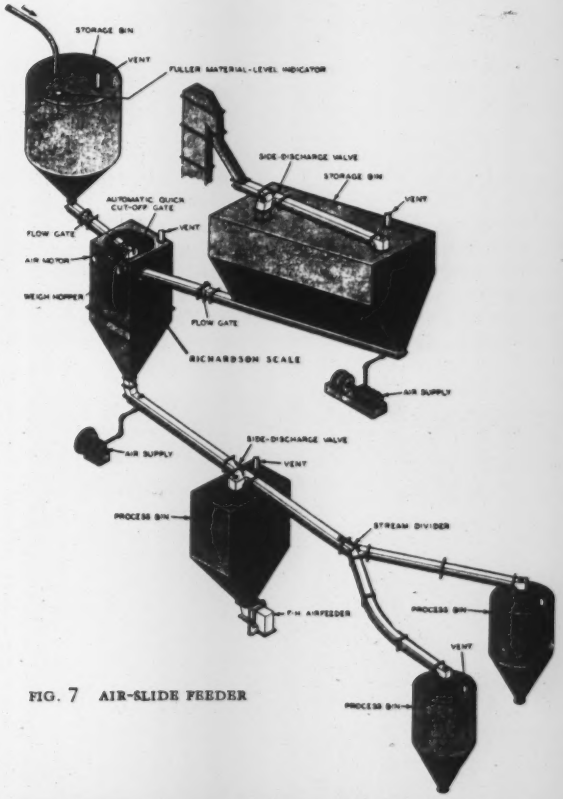

FIG. 7 AIR-SLIDE FEEDER

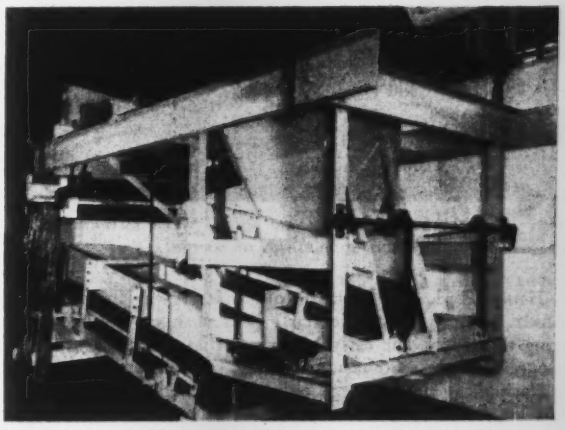

FIG. 9 COMBINATION WEIGH HOPPER AND DISCHARGE MECHANISM

vane feeder, or combination of the two, and more recently has been added the air-slide feeder, Fig. 7.

The weigh hopper may have double discharge doors for discharging sticky raw sugar or bulky asbestos, a motor-driven or air-operated radial discharge gate for releasing powdered materials. In the case of differential weighing by "loss of weight," material is discharged by belt or vibrating feeder until a prescribed quantity remains in the scale system, Fig. 8.

Sometimes the weigh hopper and the discharging mechanism are one and the same, Fig. 9, as in the case of certain continuous weighing machines. Here a quite independent belt conveyer of, say, 10-ft centers, is suspended from overhead scale levers. Under normal operation it runs continuously and receives intermittent charges of material from the feeder ahead of it. This is virtually a continuous weigher, but the stream is actually punctuated into weighed increments which can be seen in balance by the free movement of the scale beam. Thus it is a true scale and will meet the approval of weighing authorities for use in trade.

Almost any of these automatic scales can be equipped with a dial (pendulum or spring) for the purpose of providing indication, recording, and remote-weighing selection. Similar results can be obtained by using the traveling poise, motor-driven to seek automatically a balance position or a prescribed point along the steelyard, simple gearing thereafter driving the recorder or totalizer. The dial, however, is an accepted weighing medium, known and understood everywhere, and therefore has been used much more extensively in the development of automatic systems.

AUTOMATIC SYSTEMS

These and other automatic scales, each designed for the material and capacity it must handle, may be interlocked

electrically for proportioning under the direction of a centralized control system. This is the first step toward "automation in materials handling by weight," and was begun many years ago.

One of the early systems was engineered in 1933, in Detroit for the Hiram-Walker distillery at Peoria, Ill., which is still the world's largest distillery.

Here six automatic scales are combined to handle corn meal, rye meal, rye-malt meal, and barley-malt meal, each scale delivering to its own reversing screw conveyer, whereby through the operation of automatic slide gates any material can be delivered to any of the eight cookers.

Here, too, was one of the first installations of the automatic stop counter, whereby multiple drafts of an equal quantity of material can be delivered by each small scale for large batch work. Thus a small machine requiring negligible headroom and floor loading can handle unlimited quantities.

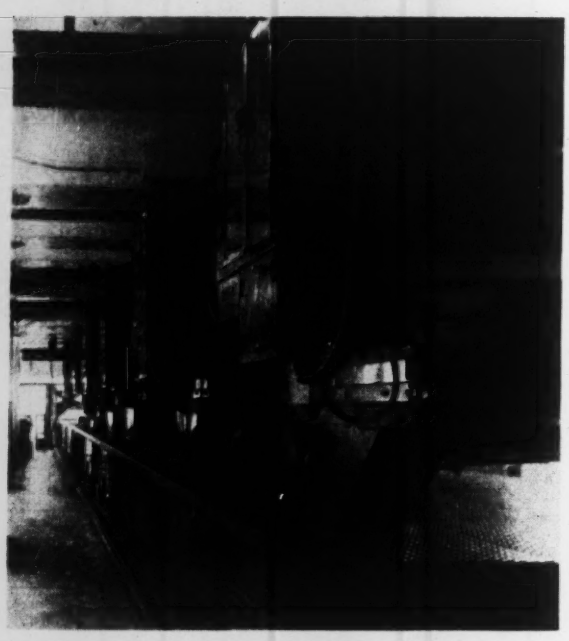

FIG. 10 INDIVIDUAL AUTOMATIC SCALES WITH INTERLOCKS FOR COMBINED FEEDING OF MATERIALS

Henry Ford, having been told that it was impossible to produce plate glass continuously, was at this same time beginning to do it. The early history of that operation as a bold step toward the automation of today, so typical of Ford, would fill a book. Here there is only time for a brief comment on the handling of bulk materials like silica, soda ash, lime, salt cake, cullet, charcoal, and arsenious oxide. This weighing and discharging was at first all done by hand on individual scales, but to keep two mixers going, each on a 5-min cycle, was too much. Some ingredients were omitted entirely, hoppers were not emptied completely, and too often a workman with a grievance would "get even" by deliberately spoiling the formula, and there was no way to check on him. Thus bad aggregate frequently would be discharged into the furnace on top of good glass and lower the quality of it all.

Here again, individual scales, Fig. 10, were installed for the various ingredients, and interlocked so that all had to complete their weighings according to formula before any could discharge. Here too for the first time, the weigh-hopper bottom was a reversible belt which would run one way to discharge to one collective conveyer serving mixer No. 1, and then reverse to discharge to a second conveyer feeding mixer No. 2. Interlocks required that all scales would discharge in the same direction, and always would alternate from one direction to the other according to the operation of the mixers.

Colored lights indicated which scales were selected "in," when their feeders were running, when their weighings were completed, which mixer line was receiving a charge, and when the scales were empty. It was advanced for its time, and is operating today nearly 20 years later, virtually unchanged.

This was the plant that shortly after that time produced a continuous strip of glass 42 in. wide without even a moment's interruption for over 3 years, a strip long enough to reach from Detroit to Hawaii. It was such early success that encouraged Ford Motor Company to continue its pioneering in automation.

Progress toward automation in distilling and glass manufacture soon spread to the feed industry where thousands of tons of animal and poultry feed are prepared daily. Few realize that feeding has become so scientific and exact that proportioning of ingredients like corn meal, gluten feed, brewers' grain, alfalfa meal, fish meal, ground oats, and so on, is required to meet the formulas as prescribed by the chemists working with major feed millers.

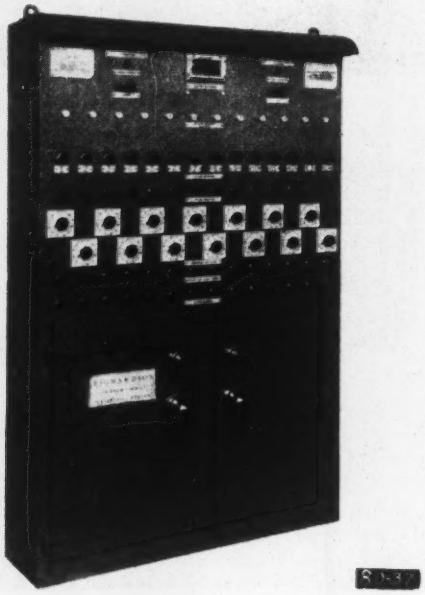

FIG. 11 CONTROL PANEL IN FEED MILL

Fig. 11 illustrates a control panel in a Maryland feed mill where any of 14 ingredients can be selected and delivered in prescribed quantities at timed intervals to alternate batch mixers. An individual automatic scale is used for each ingredient, and each scale is set to deliver a fixed quantity like 50 lb, 100 lb, or 150 lb per discharge. Thereafter each scale will deliver from 1 to 12 such weighings according to the setting at the panel board to complete a batch. Thus the unit weighing becomes a common denominator, and formulas are arranged accordingly.

All scales are interlocked, so those selected will discharge simultaneously only when all are in correct balance. One by one the scales drop out as their required number of weighings is completed, and colored lights signal the progress of the batch from the first to the last. An electric stop counter records the

number of completed batches and automatically shuts down the system after delivery of the required tonnage of mixed feed.

This system still requires the panel operator to select certain scales and establish the number of weighings of each for a given formula, and there is always the possibility of human error. This danger increases as the formulation becomes more complex, so the next step will involve the use of punched cards or templates, one for each formula, whereby all selection becomes automatic.

In such a system scores of ingredients must be weighed out by scales, making from 1 to 30 weighments to the batch. The problem here is complicated by the fact that each scale must handle from 2 to 6 ingredients through multiple feeders. Here a template, preconstructed for a single formula, is inserted in the panel, and thereafter the throw of a lever establishes all of the necessary settings required for that formula.

PROPORTIONING IN FOUNDRY PRACTICE

The General Electric Foundry at Everett, Mass., pioneering for the foundry industry in automatic materials handling, modernized its proportioning system about three years ago.

The problem there was to deliver a 2000-lb batch of prepared sand to the mullers every 60 sec. This involved automatic proportioning of shake-out sand, float sand, reclaim core sand, silica flour, and core binders such as Trueline, bentonite, Mogul, and woodflour. Fig. 12 illustrates the arrangement

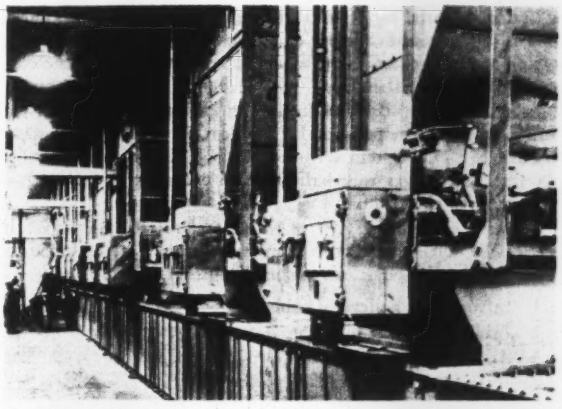

FIG. 12 FOUNDRY SYSTEM UTILIZING WEIGH SCALES, CONVEYER, SWIVEL SPOUT FEED, AND SKIP HOISTS

whereby the scales deliver to a collector conveyer which discharges to a swivel spout feeding either of two skip hoists.

This system, while simple compared to later requirements, was one of the most advanced for its time. Not only was the weighing automatic, but water, kerosene, and core oil also were injected volumetrically in timed sequence. The collector conveyer was co-ordinated with the automatic swivel spout, which in turn was interlocked with the travel of the skip hoist. Operation was protected against error as follows:

1 Scales cannot begin to make a weighing unless enough material is ahead of them to complete the batch.

2 Scales cannot discharge unless:

a All weighings are within the allowable tolerance.

b The collector conveyer is running.

c The swivel spout to the selected skip hoist has positioned itself.

d The selected skip is in place.

3 The skip cannot rise to the mullers unless:

a All scales register empty balance.

b Water has been put into the muller.

4 The muller batch automatically will be rejected unless the kerosene and core oil have been added at the correct time and in proper amount.

5 The finished batch will pass to process only if every mechanical and electrical function has been exactly as specified; otherwise the batch is automatically plowed off the conveyer and into a "reject" bin just ahead of its final destination.

ADVANCED AUTOMATION IN FEED INDUSTRY

Reference has been made already to the feed industry, but the Indiana mill of the Elkhart County Cooperative is so different and so advanced in automation that it has a place here.

This mill is designed for bulk shipment only and with a mixing capacity of 20 tons hourly, formulas constantly changing according to the demand of the bulk trucks at the loading station.

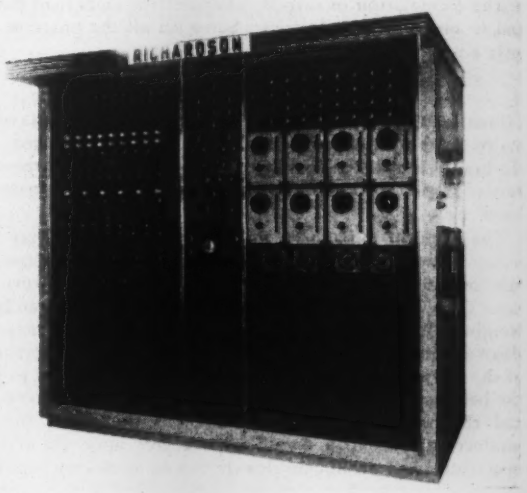

FIG. 13 CONTROL PANEL AT ELKHART COUNTY COOPERATIVE AUTOMATIC FEED MILL

Labor is reduced to one man at the master control panel, a few maintenance men, and a weighman for the outgoing trucks.

There are eight major ingredients in the hoppers above the batching scale, each being fed to the scale by its own screw-conveyer feeder.

The weighed batch is delivered by a diverter spout to either of two horizontal mixers, which in turn discharge to the conveying and elevating system going to the final storage bins ahead of the bulk trucks.

Fig. 13 illustrates the control panel, the left half containing the remote controls for all the screw conveyers, bucket elevators, sifters, diverter spouts, and slide gates; the right side contains the means for remote selection of ingredients and formulation by weight, timers to sequence the mixing operation, and signal lights to indicate the progress of the cycle. A batch-stop counter determines the number of 2-ton batches to be delivered automatically to finished storage or trucks, after which the system shuts down.

For the convenience of the operator in trouble shooting, every motor in the mill has overload indication at the panel. In overload condition, the system shuts down, and indicating lights identify the trouble and the location of the stalled motor.

When so advanced a degree of remote control is called for by a co-operative mill in a farm community in Indiana without ever a question of its ultimate success, the trend toward automation must be well established.

Author John Diebold, in his treatise on the economics and social consequences of automation,[1] points out that the mechanical and electronic problems of automation are far simpler than that of convincing a potential user of the applicability of automation to his process. Over the years, as the foregoing examples have developed from conception to reality, it is recognized that there always has been a progressive individual somewhere behind the scenes ready to venture into something new, and to take the calculated risk for the advantages that success will bring. Many another job which inevitably would have succeeded has died for lack of such pioneering spirit. But the trend is there and is accelerating, as those who succeed prove the saving in labor cost and the improvement in quality of product. It can be seen in the preparation of ready-mix cake flours, in the manufacture of refractories, in the production of asbestos board or shingles, in the preparation of baby powder, in the formulation of carbon electrodes for aluminum plants, and in many other industries; but with all the progress it is only a beginning.

APPLICATION TO RUBBER MILL

Finally, a new system now under construction for one of the major rubber companies in Ohio, will be described. To the best of the author's knowledge this represents the most advanced step in the application of automation to bulk materials handling.

The cycle of a Banbury mixer in a rubber mill has been reduced constantly over the years from 15 min to as low as 4 min, and in this short interval a dozen or more ingredients may have to be introduced in proper sequence and accurately by weight. With the formulation and delivery of material, there also is the control of conveyers, the opening and closing of the mixer door, the raising and lowering of the ram to keep the batch forced between the mixing rolls, the injection of oils, and the policing of temperatures. The quality of the end product depends to a considerable degree upon all of these operations, and the human element can no more keep pace with the requirements than compete with a calculating machine.

In this plant, formulas change frequently, and they may include any of 6 carbon blacks, 8 grades of pelletized rubber, 8 pigments, 9 oils, and 12 accelerators, a total of 43 different items. Furthermore, these materials are among the most difficult to handle.

The plan calls for a single cumulative hopper scale for each of the five groups, the levers of the scale terminating in a pendulum dial equipped with a single remote-controlled proximity flag whereby an infinite number of electronically selected cutoff points are available.

In a distant control room out of sight of the mechanical operation, is located the master control panel, which contains five follower dials to indicate to within a graduation the course of the pointers on their respective weighing dials. Thus the controlling operator can see the progress of every weighing and discharging operation without leaving the control room.

Tape recorders could have been supplied with each remote dial, but this was believed to be a superfluous refinement.

Each section of the panel is devoted to one group of materials, i.e., pelletized rubber, pigments, oils, accelerators, or carbon blacks. While there are 43 individual materials, it was determined that no more than 17 ever would be required for any one formula, so only 17 weight-selector verniers were supplied on the panel, any one of which can be assigned by a selector switch to any of the ingredients in its classification.

[1] "Automation," by John Diebold, D. Van Nostrand Company, New York, N. Y., 1952.

In any automatic weighing operation it is necessary to cut off the flow of material before the exact weight has been reached to compensate for the falling column of that material between the feeder and the load in the hopper. Thus if 50 lb is wanted, ordinarily it might be necessary to establish the cutoff at 48 lb. This was considered confusing in this compounding operation, so a second "compensation" vernier, graduated in pounds, was located below the master weight selector, and this is set for the amount of compensation in pounds. Thus for the foregoing example, the master vernier would be set at 50 lb of required material, and the compensator at 2 lb to advance the cutoff accordingly.

The remote weight control is accomplished in this case by an electronic proximity-switch flag on the scale dial which advances to the position pre-established by the vernier on the panel, which in turn schedules the first of a series of cumulative weighings. The feeder of the vibrating type assigned to the vernier, automatically starts up and delivers material to the weigh hopper until the scale pointer, in advancing, meets the proximity flag and then stops. The proximity flag then advances immediately to the second position as determined by the second vernier on the panel, and the second feeder begins delivering its material to the weigh hopper in cumulative weighing procedure. In the case of oils, valves are opened and closed rather than feeders being started and stopped.

This operation is repeated until all selected materials have been accumulated by weight in accordance with the formula. The batch is retained until the proper moment in the mixer cycle, at which time it is discharged automatically to the conveyer belt feeding the mixer.

After discharge, the proximity switch relocates itself at the zero or tare-balance position for verification of complete hopper discharge. The system will not recycle if any weigh hopper fails to show a tare balance, and pilot lights will signal the source of the trouble.

To schedule the delivery of solids and oils to the mixer in accordance with the chemist's program, timers are included for sequencing such operations as the following:

1 Introducing pelletized rubber.
2 Adding staining oils (1st, 2nd, and 3rd dose).
3 Adding nonstaining oils (1st, 2nd, and 3rd dose).
4 Introducing carbon black to the mixer.
5 Adding pigments (1st and 2nd dose).
6 Adding accelerators (1st and 2nd dose).
7 Opening the mixer-discharge slide.
8 Closing the mixer-discharge slide.

As complete as an automatic system may be, it is necessary to maintain flexibility so that a responsible man can take over at any point in a cycle and operate it according to his own human judgment. To accomplish this, a manual control turret is located at the mixer, and by throwing a switch from "automatic" to "manual" all operations are performed by manual push button.

CONCLUSION

This paper reports progress which actually has been made toward automation in bulk materials handling. The progress has been real and substantial, thanks to the pioneering spirit of engineers and production men who were willing to gamble time and money in the hope of lowering costs and improving quality. It is safe to conclude that with such marked success in so short a time, the trend will continue. It is hoped that the examples and illustrations cited here will suggest others to any who are interested in automation, and will encourage them to seek its advantages in materials handling.

MACHINING

Integrally Stiffened Structures

By J. C. BORGER

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THE history of aviation has seen a never-ending struggle to produce lighter and stronger airplanes. From the tube-and-fabric days to all-metal design—to the high-strength aluminum alloys—each step in advancement of design correspondingly involved the use of new lighter materials. Each step toward better structure involved also improved structural methods and advancements in the use of these lighter and stronger alloys. From the conventional structure of stringers and skin has finally evolved the next step in structural design—the integrally stiffened panel; this means basically, a one-piece structure which consists of outer or skin surface and inner stiffener members. These units may be produced by extruding, rolling, forging, or machining, or by a combination of all.

With this advanced concept of structural design and with the simultaneous use of high-strength alloys, the door is open to lighter, faster, more economical aircraft. At the same time, however, this advanced concept raises many design and manufacturing problems we must solve if we are to take full advantage of it. These problems fall generally into two classes—those caused by material and those caused by machining.

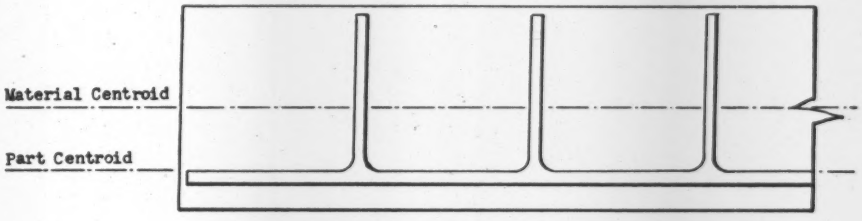

FIG. 1 PLATE STOCK AND PART RELATIONSHIP

These problems, although easily classified under these two headings, go together. Material affects machining and machining affects material. With this in mind and as a means toward simplifying discussion, each heading will be discussed separately.

MATERIAL

The material discussion will be on rolled plate. During the design-development stages leading up to the use of integrally stiffened structure, consideration was given to the determination of optimum size of panel to be produced. Vendor limitations on thickness, width, and length were based on alloy, maximum ingot size, capacity of rolling equipment, heat-treating furnaces and quenching tanks, straightening rolls or stretcher levelers, transportation facilities, and so on. Also, during fabrication of the first experimental panels, both straightness of the material before machining and straightness of the part after machining pointed up the following facts:

1 Before machining, material must be relatively free from bows, reverse bends, crowns, and the like, to allow for proper holding and support during machining operations.

2 If during machining a part bows or warps excessively, such condition is attributable to high residual stresses which are released during removal of material and necessitates use of relatively stress-free material; this in turn means careful control of flattening or straightening operations by the vendor.

3 If material is not entirely stress-free (and we have yet to see any such material), final longitudinal and transverse warping or bowing can be generally estimated and final effects somewhat modified by careful sequence of machining operations; this means basically removing material so that the centroid of the part is located as near to the centroid of the raw material as possible, Fig. 1.

The first production integrally stiffened structure to be made of machined plate was limited to panels 32 ft long and not exceeding 48 in. in width because of ingot limitations. Thickness of $1^3/_4$ in. was considered to be the minimum required for machining, as design height of stiffeners was $1^1/_2$ in. Specific requirements were established for maximum flatness in the longitudinal direction; this tolerance was originally established at $^1/_8$ in. in 6 ft, measured as the plate rested flat on a surface with the weight of the plate tending to minimize the bow. Recently this specification has been changed to a standard rolled-plate tolerance of $^1/_4$ in. in 6 ft, but with measurement taken while the plate is resting on its edge.

It is further to be noted that the manner in which bow occurs is more important than the extent of the bow. A gradual arc from end to end of the panel, with "crown" height of, say, 2 in. would be far easier to control than a reverse bow or S-shaped condition with individual crown heights of $^1/_2$ in., Fig. 2. Transverse bow was accepted to standard rolled-plate tolerance, $^1/_4$ in. in 6 ft, and in most cases is handled by side clamps during machining.

A general sequence of operations, based on tests and data collected during development stages, was determined so that the maximum amount of material was removed from the skin side. The effect of this procedure is deliberately to cause crowning in a direction opposite to the crowning effect which results from machining the stiffener side. Although it would

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be more desirable from the residual-stress viewpoint to place the panel crown up on the machine for the skin-side operation, this generally is not done because of inability of vacuum chuck to pull the panel down and hold the panel flat; hence violation of theoretical best sequence occurs strictly because of necessity to clamp the part to the machine table.

Because of inconsistencies of material, neither the amount of "crowning" nor the location of localized crowning can be predicted accurately. General tendency of the material to crown establishes a basic machining sequence; any deviation from average conditions causes undue warpage and subsequent costly straightening operations. As an example, consider the bow of the C-130 panel, 55 in. in 48 ft, Fig. 3. A further design requirement makes it necessary to provide heavy attachment pads running transversely across the panels; at these localized areas the stringers are cut away and, Fig. 4, invariably at such locations definite kinks occur. These are most difficult to remove by subsequent forming operations. At the ends of panels, to provide for attachment, the stiffening members are tapered flush; this results in the same general condition. The primary difficulty we have encountered with material is the uneven distribution of residual stresses. We are convinced that the material manufacturers can either eliminate this condition or control it so as to lessen this very serious problem in the production of integrally stiffened panels.

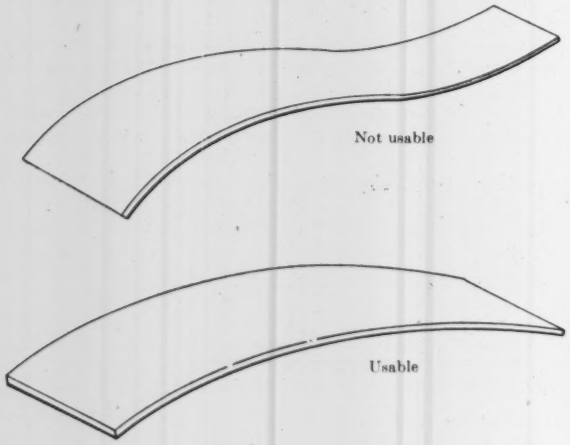

FIG. 2 PLATE STOCK FOR INTEGRALLY MACHINED SKINS

MACHINING EQUIPMENT

The only machine equipment which could be used for machining panels such as were considered in initial design development stages was the spar mill. This machine, designed primarily for fabrication of beams, spar caps, and similar structural parts is a gantry-type machine with fixed bed, and with motor heads mounted both vertically and horizontally. The horizontal head is mounted either on a parallelogram or on a swinging arm which is actuated by rollers riding on a cam or profile bars to control the rise and fall cutting, Fig. 5.

The equipment is limited as to capacity—the maximum width of part which can be handled is 24 in. The rise and fall mechanism, although simple and straightforward, is subject to deflection during machining operations. Owing to the large diameter of the motors, the spindle length for maximum-width parts must be approximately 30 in. long; this condition creates

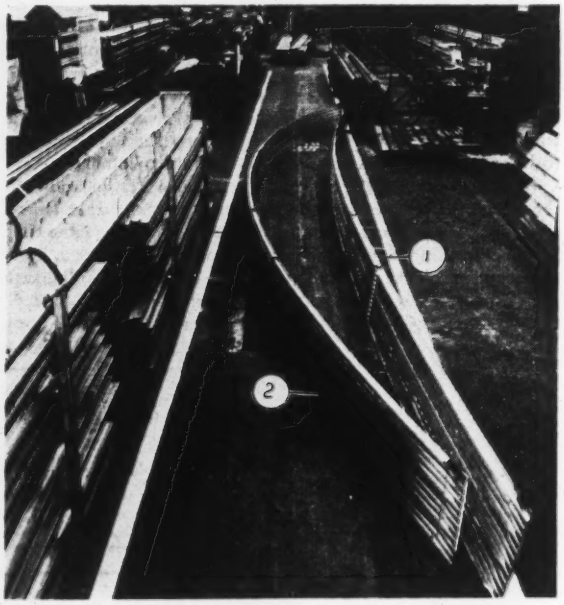

FIG. 3 MACHINED INTEGRALLY STIFFENED SKINS, MODEL C130
(1 Proper machining procedure; 2 improper machining procedure.)

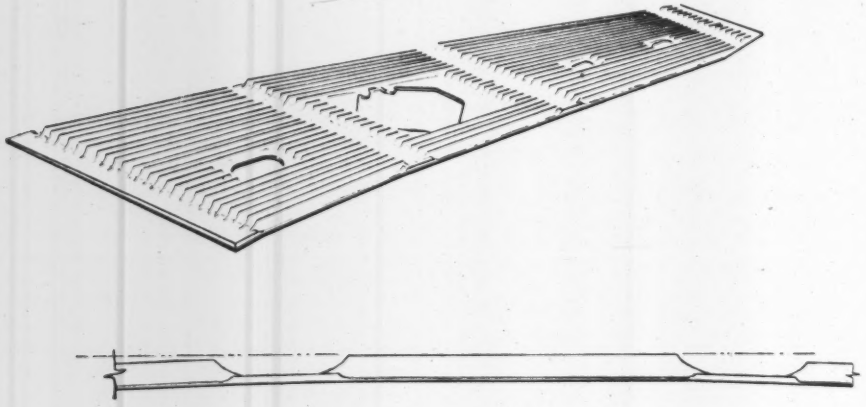

FIG. 4 CONSTELLATION MACHINED SKIN

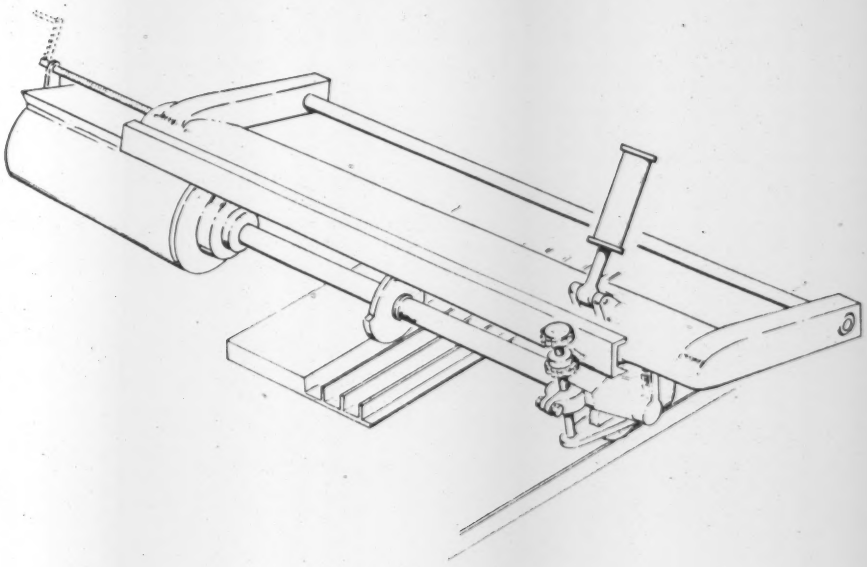

FIG. 5 ONSRUD SPAR MILL-CUTTING HEAD MOUNTING

spindle vibration and chatter and consequently results in poor finish and increase in required machining tolerances.

The vertically mounted heads do not provide the correct rpm and horsepower nor do they provide for adequate transverse movement and, therefore, are unsuitable for precision surfacing operations. Other types of equipment such as boring bars, conventional mills, and the like, were entirely impractical for this type of work.

Because available equipment was inadequate, it was necessary to design a machine specifically adapted to produce integrally stiffened structural parts. The final decision was to use a conventional planer-type milling machine equipped with three heads and with profiling mechanism for both horizontal and vertical movement. The final result, the skin mill (housed in the Lockheed Hall of Giants), Fig. 6, is a planer-type

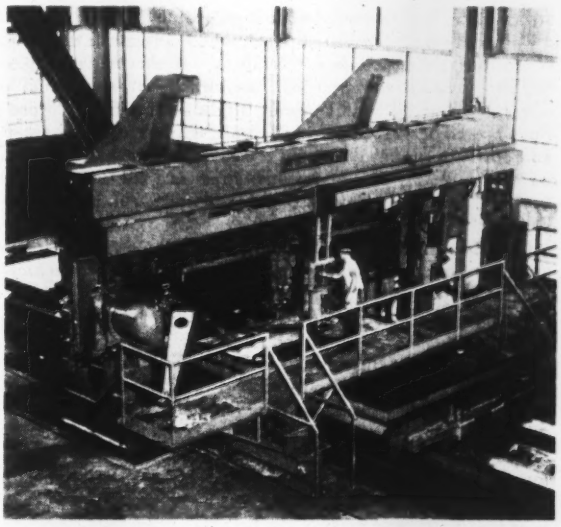

FIG. 6 GIDDINGS AND LEWIS SKIN MILL IN LOCKHEED HALL OF GIANTS

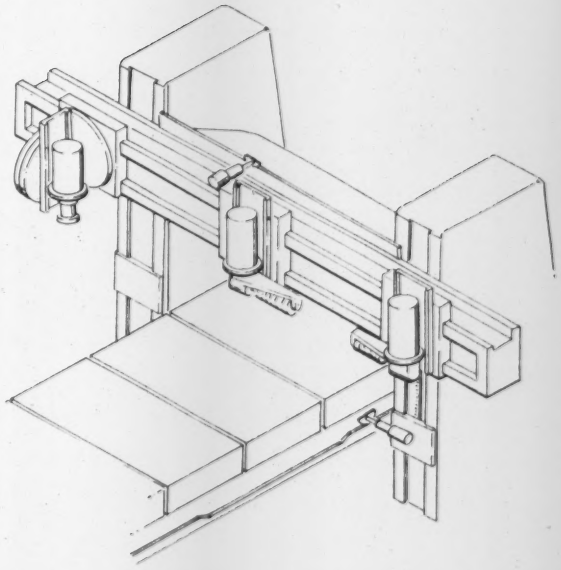

FIG. 7 SKIN-MILL CUTTING-HEAD AND TRACING-UNIT RELATIONSHIP

milling machine, 10 ft × 34 ft with milling heads arranged for profiling vertically and/or horizontally, Fig. 7.

The vertical profiling (rise and fall) mechanism consists of a tracing wheel and hydraulic tracing valve which controls rise and fall of the cutter motors by means of hydraulic cylinders. The motor in turn is connected to the tracer by mechanical linkage—which is a feedback arrangement intended to maintain proper relationship between cutter and tracing head. The tracing wheel is actuated by cam bars located on either side of the machine table for rise and fall movement over the length of the table, Fig. 8. For cross-table rise and fall, the tracing mechanism operates from cam bars located on the rail of the machine; this hydraulic tracer is mounted directly on

the cutter head; therefore no feedback mechanism is required.

The three heads are mounted on the rail in such a manner that each head may give full coverage of the table width without interference with the other heads. In order to have this coverage, a 27-ft rail is required—this aggravates the distance relationship between cutter head and tracing mechanism and is the prime factor affecting accuracy.

The table is operated by a 25-hp motor controlled with an amplidyne circuit to give infinitely variable feed up to 150 ipm. The cutting heads are mounted on individual slides on the rail which in turn is manually adjustable vertically within a 29-in. range. Right-hand and center heads are tracer-controlled for vertical operation within a 4-in. range both lengthwise and crosswise of the table, and are also adjustable manually within a 12-in. range. The left-hand head is adjustable manually within a 12-in. range, but is not tracer-controlled for vertical movement. This head is designed as a 360-deg profiler in the plane of the table and is controlled by an electronic tracer operating from a flat template mounted on the table.

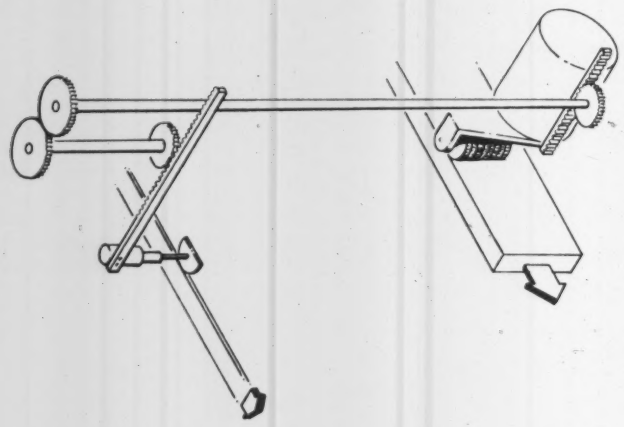

FIG. 8 FEEDBACK MECHANISM FOR HYDRAULIC TRACER CONTROL

Center and right-hand heads are powered by high-cycle motors developing 100 hp at 3500 rpm; the left-hand head develops 100 hp at 7200 rpm—all three heads have infinitely controlled speeds. Cutter speeds being used are in the order of 12,000 sfm; this apparently is an optimum condition to obtain surface smoothness and good tool life with today's cutter designs and equipment.

Auxiliary equipment for the skin mill consists of hydraulic system, pumps, lubrication and coolant system, vacuum pump, and chip-disposal mechanism. The total connected load of the installation is 1500 hp. The equipment weighs 400,000 lb, costs $500,000 (without accessory tooling), requires a floor space of 2400 sq ft, and a basement installation of 900 sq ft for cycle changers and control equipment.

If utilized to the fullest extent, the machine is capable of removing 3 cu in. of aluminum alloy per hp min. Limitations on the tracing mechanism, however, have made slow feed speeds necessary, and often only 100 lb per hour per head are removed in actual production.

In originally designing this equipment, a great deal of effort was expended to make it completely universal so that it could handle any type of design that might be contemplated. The initial concept indicated a machine capable of sinking dies up to 4 in. thick to profiling sheet metal parts as thin as .016 in.

As a result of specifications toward this end, therefore, many minor deficiencies have arisen that probably would not have been incurred in a single-purpose machine. And we believe the major difficulties encountered are a result of specified requirements and not necessarily because of poor construction.

The most important problem found in present-day equipment centers around the tracing mechanism operated by cams. At high feed rates, overriding or overcontrol occurs. This seems to be a general condition inherent in hydraulic tracing systems with mechanical feedback. Also, the distance relationship between head and tracing unit requires a mechanism in which torsional effect, deflection, and lost motion in the linkage results in inability to control an exact relationship between tracer and head.

Another disadvantage in the operation of the machines is the excessive time necessary to establish cutter settings, not only for position of cutter, but also for depth of cut. At present this is done by time-consuming trial and error, using calibrated rods and dial indicators.

In general we feel that the machine tools now being used to produce integrally stiffened structures have created many new problems that are a great challenge to engineers, manufacturing men, and equipment producers. Some of these are:

1 To develop a means for speeding up feed rates.

2 To devise surer ways for machines to hold close tolerance.

3 To reduce load time.

4 To speed up and improve the accuracy of cam changing and positioning.

5 To design and build more adequate systems for chip disposal.

6 To cut down on maintenance required.

7 To provide for quicker change and more accurate cutter positioning.

8 To work out more adequate table-positioning ment.

CONCLUSION

Some of the history behind the development and use of integrally stiffened structure has been mentioned, pointing out material and machining factors involved in producing these structures. The material with high residual stress results in a warped, bowed, or twisted panel, which affects the machining operations and machining tolerances. If the material is too highly stressed and warped, machining is impossible. If stress and warped conditions are slight it may be machined—but a bowed or warped part will result, which requires extensive and costly forming operations. On the other hand, if material is reasonably free of residual stress and the machine cannot produce the part to reasonable tolerance, the part is overweight.

On panels for the Constellation, for instance, .001 in. thickness amounts to approximately 10 lb per airplane. Machining tolerances must be kept on the plus side to preserve structural integrity. Weight of present panels may vary in the order of 100 lb per airplane.

The advantages of using an integrally stiffened structure are tremendous, but these advantages are entirely dependent upon ability to produce straight flat parts machined to close tolerances. These very great advantages could all be lost to the aircraft industry unless there is a determined effort made jointly by material suppliers to produce good material, machine tool manufacturers to build equipment to produce good close tolerance parts, and users of the material and equipment to find solutions to the problems that certainly could have been expected in the pioneering of such a radical new process.

When Should a Paper Have JOINT AUTHORSHIP?

By WALTON FORSTALL, JR.,[1] AND WILLIAM F. STOKEY[2]

CARNEGIE INSTITUTE OF TECHNOLOGY, PITTSBURGH, PA.

PRESENT-day project research is usually carried out by more than one person. In the typical instance of an investigation conducted by a research laboratory, many people, ranging from the laboratory director to the technicians, contribute to its success. When the research is reported in the form of a paper offered for publication to a technical journal, who should be listed as authors and what constitutes proper acknowledgment to those others who have participated in the work? Answers to this question might be classified as part of the etiquette of science which, like social etiquette, is governed mainly by custom. Unlike its social analog, however, almost nothing has been written about what constitutes a desirable standard for scientific etiquette in connection with joint authorship.

A library search has revealed only one paper in which the subject has been mentioned.[3] It is the purpose of this article, keeping the emphasis on what should be done rather than what is done, to examine some possible standards of desirable practice in the matter of authorship and acknowledgment in technical papers.

That this is a matter of some current interest is apparent from the fact that the number of articles with multiple authorship is increasing. Today it is not unusual to find papers with four names listed as authors, and bibliographies often refer to multiple-author papers by the form "Jones, et al."

FORMS OF RECOGNITION

There are at least three ways of recognizing individual contributions to a scientific paper: (*a*) listing as an author, (*b*) mention in an acknowledgment, and (*c*) a reference citation, which may include unpublished or private communications. In many instances there is no doubt as to the proper form of recognition. For example, a single author may write a paper, acknowledge help from colleagues and technicians by name, and cite the references he used. But there are also many instances in which the proper form of recognition is not obvious, especially as regards authorship. With respect to the uncertain cases, let us consider by what criteria the question of authorship might be decided, in the knowledge that other means of recognition are available for those who do not qualify for authorship.

While we usually think of an author as being a writer, Webster's dictionary has additional meanings for the word, defining "author" as: (1) The beginner, former, or first mover of anything; hence, efficient cause of a thing; creator; originator. (2) One who composes or writes a book; a composer, as distinguished from an editor, translator, or compiler.

Even in nontechnical writing, "authorship" may imply one of a number of things. The author of a novel is usually considered to be the originator of the plot, i.e., to supply his own ideas, as well as the one who actually puts down the words. In such a case the author satisfies both parts of the dictionary definition. Sometimes a novel has two authors. What does this imply? In some cases it probably means that one of the authors supplied most of the ideas, while the other had the gift of putting the ideas into readable form.

The "ghost" writer is often used in nontechnical writing. In work done by the ghost writer, the name of the writer himself, that is the ghost, may not appear as an author at all. Presumably, he has been paid adequately for his efforts, and is content to receive no personal recognition. In this case the person whose name appears as author probably is well known, and for that reason the arrangement is profitable from a commercial viewpoint. For example, the biography of a well-known person by an unknown author may have little sales appeal, while the same work, with the word "I" substituted for "he" and published as an autobiography, may become a best seller. Unfortunately, the approximate equivalent of this is sometimes resorted to in technical writing, although normally the true author's name appears as well as the name of the well-known person. Here, the reasons are usually not monetary, but may stem from two things: The paper may be more easily accepted for publication if a well-known person appears as author; also the well-known person may take advantage of his position to get his name on the paper.

The author of a textbook on a technical subject may or may not contribute any original ideas; he may feel that he can explain some subject in a particularly lucid manner—a thoroughly commendable objective but carrying with it the obligation of giving proper recognition to sources of material.

In a technical paper, authorship usually implies something more than merely writing down thoughts that the author has taken from other sources; the technical paper is the researcher's means of telling what he has done, and it is normally assumed that the author of a technical paper not only has written the paper, but has made a substantial contribution to the research described. If this is true, the author has fulfilled both parts of the dictionary definition of author.

WHO SHOULD APPEAR AS AUTHOR OF A PAPER?

Fortunately, most people who engage in research are anxious to have the results of their work made known, and therefore write their own papers. In some cases, however, a person may carry out an excellent investigation and not want to, or perhaps not have time to describe it in writing. Suppose some other person does this for him; who should appear as author of the paper, or should both?

Two criteria that might be used as tests for authorship are the two parts of Webster's definition—that is, that an author either should supply ideas, or do some of the actual writing, or both. In considering the significance of this statement, it should be pointed out that the technical paper is the product of an "intellectual" effort. Thus the test that must be applied to either the supplying of ideas or their translation into written

[1] Associate Professor, Department of Mechanical Engineering, Carnegie Institute of Technology. Mem. ASME.

[2] Assistant Professor, Department of Mechanical Engineering, Carnegie Institute of Technology. Jun. ASME.

[3] "The Presentation of Technical Information; the Administration Aspect," by F. M. Colebrook, *Engineering*, vol. 170, 1950, pp. 260–261.

words is the discernment essential to either contribution. Operations like typing, preparing figures, making calculations which are already planned, performing measurements as instructed, all are nonintellectual routines. The element of invention, of independent judgment, must appear as the validating factor in either of the two authorship criteria.

There are still some difficulties. How many ideas and how much writing are needed to qualify as authorship? Certainly, if Brown writes the introduction, Green, a description of the test, and White, the conclusions, this is joint authorship. It is also clear that neither the casual suggestion of an unimportant idea nor the contribution of a sentence or two constitutes authorship.

In short, the suggested criteria are only a start and the subsequent questions of degree, like all such problems in human relations, involve boundaries that cannot be defined sharply. Each case must be decided on its merits according to one's best judgment.

CRITERIA FOR AUTHORSHIP

Forgoing any attempt now to make specific suggestions regarding degree of participation, let us restate the twin criteria we propose for authorship qualification. To be listed as an author one should have contributed substantially to the ideas around which the paper is written, or have written an appreciable portion of the paper, or both. Contributions of ideas or writing insufficient to constitute authorship should be acknowledged, if recognition is properly merited, by one of the other available methods listed earlier.

It must be acknowledged frankly that a serious obstacle opposes any complete adoption of the general criteria suggested. This is the extreme professional importance to the individual of having his name appear as the author of a paper. Recognition, reputation, promotion, and emolument often depend heavily upon this factor. Has not this situation been influential in increasing the number of multiauthored papers? A great deal of effort goes into the preparation of a good technical paper and the temptation for riders to climb aboard the finished vehicle is tremendous.

In view of the existing system and its pressures, one must expect that many project directors will want their names on each paper prepared by a subordinate research worker. It would seem, however, that a minimum requirement for authorship should be that the supervisor take an active part in the writing of the paper or contribute substantially to the ideas that it contains. Here we must make the distinction between merely ordering that the investigation be undertaken and taking an intimate part, albeit supervisory, in its prosecution. It is the job of the research director to suggest problems that need attention and to specify that certain ones be investigated but this administrative function does not of itself make him an author of any resulting paper. Furthermore, it would seem reasonable and proper that the order in which the names are listed should indicate the degree of participation by putting the supervisor's name second, if his part was minor. Where the supervisor's reputation is well established, this says, in effect, "prepared by Unknown under the supervision and with the active assistance of Known." The reverse order would indicate, "written by Known with some help from Unknown."

We also must consider the author relationship among several collaborators below the administrative level of project supervisor. As suggested previously, a proper practice would seem to be to list as authors only those who contribute substantially. In a short, unified article this would not often be more than two. In choosing among co-workers on the basis of their part in the paper preparation, we are again beset by problems of degree. Furthermore, we have here the same desire for recognition among laboratory workers as that which affects their superiors. But for those who are not really authors, there are other means available to acknowledge their contributions.

In contrast to the situation in which all contributors are looking for some form of recognition, it is possible to find groups in which considerable help is freely given without thought of acknowledgment. An author may circulate his paper among his colleagues for comments and suggestions and the result is often a sizable contribution to the completeness and polished style of the paper. Since this help is available to each staff member, the net result is that each man has the opportunity for producing a paper of higher quality than if he were working alone, and this represents a real and proper recompense for his efforts on behalf of his co-workers.

ACKNOWLEDGMENT OF ASSISTANCE

When appropriate, it is customary to devote at least one paragraph of the technical paper to the acknowledgment of help from others, including financial support. Since a great many people often contribute time and effort, the problem here again is where to draw the line. Financial support always should be acknowledged; so should important contributions of ideas. Purely technical help of routine workers, like computers and mechanics, however skilled and faithful, seems not to require mention. This should not be interpreted as lack of gratitude; indeed, one's personal thanks should be expressed to these coworkers in as sincere and effective a way as possible, within the laboratory family. Again, the test here is the degree of intellectual contribution. It is neither necessary nor proper to include a long list of credits for everyone who took part, as does a motion-picture title sequence.

The authors of this article are fully aware that the whole matter is controversial and that strong winds of individual opinion are likely to blow from all sides. There will be those who prefer to list as authors the several names of all research participants, to provide what they believe to be proper recognition for their contributions. Regardless of what is said or written, people will continue to do as they please, and in the end, custom, the will of the majority, will set the style. But in the opinion of two people, at least, there do exist valid and limiting tests of authorship.

Rocket-Propulsion Motor

THE development of a rocket-propulsion motor capable of producing more than 20,000 lb of thrust was announced by the General Electric Company, Schenectady, N. Y.

Using the conversion formula in which 1 lb of thrust equals 1 hp at 375 mph (at sea level), the 20,000 lb of thrust would be equal to the power of two 2000-hp locomotives pulling a train at sea level.

The new motor, it was explained by the company's Aeronautic and Ordnance System Division, has proved to be safer and more reliable than any other of its kind in existence.

Although security regulations prevent publication of detailed information on the motor, some of its many applications suggested by G. E. engineers include aircraft and torpedo propulsion, glider takeoff and landings, and aircraft braking; it also may be used as a catapult energizer, rocket booster, and landing-craft booster. The design of the motor is such that it can be "bundled" to meet a wide range of thrust requirements.

According to the company, the propulsion motor is made of noncritical materials, can be mass-produced economically, and uses propellants readily available.

Progress in the MANUFACTURE *of* MOLDED-RUBBER PRODUCTS

By J. H. GERSTENMAIER[1] AND F. J. FETTER[2]

THE design engineer takes for granted a wide variety of molded-rubber products. He quickly classifies engine mountings, vibration dampers, rubber bushings, seals, flexible couplings, and rubber joints as exclusive fields for molded rubber. The automotive, appliance, oil-producing, mining, aircraft, and miscellaneous hydraulic and pneumatic-equipment manufacturers now depend upon molded rubber as an irreplaceable component for their products.

The rapid development and expansion of the molded-rubber-products industry is plainly evident when today's products are compared with molded products produced before World War II. The ability of molded-rubber or rubber-and-metal products to damp vibration, seal, cushion, and resist abrasion, coupled with a growing knowledge of its adaptability to fill industrial needs, has expanded its use greatly. However, the production application was made possible on a large-volume economical basis by the simultaneous development of the rubber-manufacturing processes, controls, and equipment.

Today, the typical plant devoted to the manufacture of molded-rubber products must be capable of producing parts to very close dimensional tolerances, of controlling compound physical properties to an exacting degree, and of inspecting and testing parts to assure they meet functional requirements for the many and varied industrial, transportation, and appliance fields. Electronically controlled cutters, carefully controlled cementing and drying machines, press cycles automatically regulated, higher vulcanizing temperatures and molding pressures, cold-temperature tumbling for flash removal, and conveyerized load-deflection testing machines—all have aided in this progress toward more proficient and exacting manufacturing techniques.

As a result, molded-rubber manufacturing has developed as an important division of the rubber industry. Industrial molded-rubber products no longer are considered side-line products to fill a few excess hydraulic presses in miscellaneous mechanical-goods plants. Manufacturing processes have developed which are applicable only to molded products and are even further specialized to apply only to certain types of products in the industry. This paper will show the progress in manufacturing techniques that has taken place to lead the industry away from the general classification of miscellaneous mechanical rubber goods to the highly specialized category of industrial molded product manufacturing.

The basic mixing of the rubber compound will be excluded from this paper because the manufacturing techniques here closely follow those used for any rubber-manufacturing operation. A plant devoted to the manufacture of molded-rubber products probably will have one or more Banbury mixers, plus other basic machinery with variations in size or supplementary equipment, depending upon the quantity and type of rubber compound usually produced. The specialized operations begin when the mixed compound is being prepared to the correct shape and size for molding; therefore the following steps through the factory will be discussed: (1) uncured-rubber preparation, (2) metal preparation, (3) mold design and curing, (4) finishing processes, (5) inspection and testing.

Preparation of Uncured Rubber

Uncured rubber which ranges from a soft gumlike material to a leathery hard material is shaped prior to the actual molding operation by calendering, tubing, or slabbing methods. These are standard rubber-manufacturing operations, and it is only the variations or the refinements of them for specific molded-product purposes that has made these compound-preparation methods distinctive for a molded-rubber-product plant.

The type of compound, quantity requirements, required size and shape of the mold preparation, and method of molding determines the type of preparation machinery that will be utilized. A large $^1/_2$-in-thick 30-in-diam piece of rubber most likely will be slabbed from a mill and template-cut to size; a coated-fabric preparation for a diaphragm will be prepared on a calender and die-cut to the proper size on a punching machine, whereas a piece of rubber $^1/_2$ in. long × 2 in. OD will be tubed in a continuous length from a tube machine and by means of a synchronous operation or a later operation be cut to the proper length. These are conventional methods with which those familiar with the rubber industry are acquainted.

The changes that make them especially applicable to a molded-rubber-products plant are the changes necessary to provide utmost accuracy or efficiency. The electronic cutter,

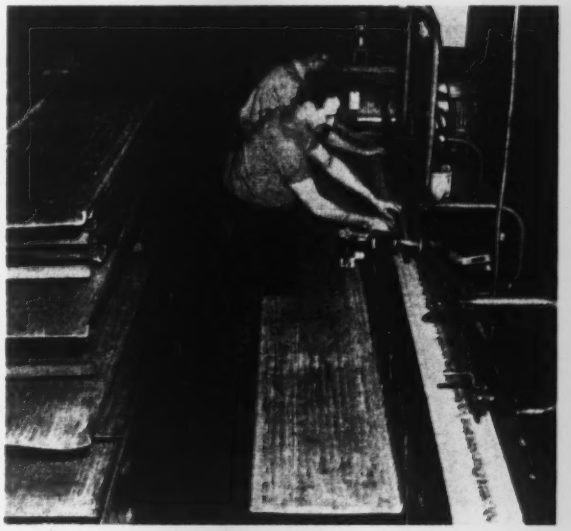

FIG. 1 ELECTRONICALLY CONTROLLED CUTTER SYNCHRONIZED WITH TUBE MACHINE

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Contributed by the Rubber and Plastics Division and presented at the Spring Meeting, Columbus, Ohio, April 28–30, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Fig. 1, is an example of this, where the cutting operation is synchronized with the tube machine and the rubber is cut accurately to the desired length.

As the methods of molding change, the demand on the preparation division also changes. The conventional method of molding an item is to place a piece of uncured rubber of the proper weight and size in/or adjacent to each cavity in the mold. This requires relatively small-size tubing, extensive cutting, and check-weighing operations. With the newer transfer and jet-injection molding methods, the requirement is for large pieces of tubed or calendered rubber sufficient in volume for one piece to fill all of the cavities in the mold. This demands larger equipment with provisions for cooling the large sections of rubber adequately.

METAL PREPARATION

Many molded products have inserts of metal, fabric, hard plastic, carbon, and so on, incorporated in their design. At the beginning of World War II aluminum presented problems of bonding that almost eliminated integral rubber-aluminum products from the realm of practical manufacturing. Today, steel, cast iron, aluminum, stainless steel, die-cast metals, magnesium, and almost all alloys or basic metals are being bonded successfully to rubber, with adhesion strengths often exceeding the ultimate tensile strength of the rubber compound.

The attainment of a satisfactory bond is only the first consideration because the further requirement that the bond be produced readily in quantity on a consistent basis is equally important. Since there is no universal method or no all-purpose cement to handle all combinations of compounds and inserts, it is generally necessary to have sufficient equipment to produce the best and most uniform type of adhesion for each specific application. The required equipment will depend upon the type adhesion used.

There are two basic types of adhesion methods in use today, namely, chemical and mechanical. In both methods the actual bonding of the rubber to the insert takes place while the product is being formed and cured in the mold.

The brass-plate method, utilizing a carefully controlled brass bath (approximately 30 per cent zinc, 70 per cent copper) is classified as a chemical type. This method, used by many rubber companies, deposits a brass plate on the metal insert

FIG. 2 AUTOMOTIVE BRAKE-PEDAL-PAD METALS ARE BEING PLACED ON RACK WHILE PLATED INNER TRUCK-ENGINE-MOUNT METALS ARE BEING REMOVED

FIG. 3 AUTOMATIC ADHESIVE-CEMENT APPLICATOR AND CONTROLLED DRYING CONVEYER

(Aluminum-aircraft-mount bell metals are shown at beginning and end of cementing and drying cycle.)

which reacts during the curing cycle with certain ingredients of the compounded rubbers to form another chemical composition at the surface of the metal which in turn provides a strong bond between the rubber and metal. The use of brass plating for adhesion is recommended highly for providing a consistent and dependable method of obtaining satisfactory bonds which will withstand a wide variation of functional requirements Examples of the process are shown in Fig. 2.

It may be necessary to remove excessive grease or heavy oil by degreasing or to remove heavy scale by grit or sandblasting prior to plating. A hand sandblast operation can be utilized to clean the bonding area on small inserts with thin cross sections. Grittumblasting operations in machines, varying from 5 to 17 cu ft content, can be used for the majority of metal inserts.

Mechanical-type bonds are obtained by the use of chlorinated rubber or phenolic-resin-base adhesives, these methods being required for different combinations of natural or synthetic rubber and for different metals where brass plating is not adaptable or available.

Metal inserts always should be cleaned carefully by some prior operation, sand or gritblasting, degreasing, and so on. The adhesive should be agitated and at the proper temperature brushed, sprayed, or dipped on the area to be bonded. The age, viscosity, and general condition of the adhesive is critical and must be controlled, and the application and drying of the adhesive must be regulated carefully, Fig. 3. In addition, many of the adhesives are unstable in humid air and must be covered immediately with another more stable rubber cement.

MOLD DESIGN AND CURING

Much of the progress or development in the industry can be attributed to the great advancement and specialization in the pressroom or curing operation.

Conventional or compression, transfer, and full injection-molding comprise the mold processes available today. Plants specializing in the manufacture of molded-rubber products, and capable of producing all types and sizes of industrial products, will have groups of curing presses in the rage of 12-in. × 12-in. platens to 40-in. × 40-in. platens, with special-size presses developed for specific products or product lines. Curing temperatures ranging from 290 F to 360 F and unit hydraulic pres-

sures ranging from 1200 psi to 2500 psi normally are used, although platen temperatures exceeding 360 F can be obtained when necessary by electrical heating devices.

Compression Molding. The majority of molded-rubber products are produced by conventional molding processes (Fig. 4); that is, the uncured compounded rubber is prepared to the correct size and weight placed in/or adjacent to the cavity, and forced into place by the pressure of the mold closing in the press.

Both conventional and automatic molded-products presses are versatile and adaptable to a large line of products. In either case, the trend has been toward equipment with temperature controls, automatic timers, and controlled pressures that will allow parts to be molded with closer dimensional tolerances, with higher pressures, and with more accurate cures. An automatic mechanical-type press is shown in Fig. 5.

Hydraulic presses which originally were considered standard multipurpose presses by the press manufacturer, in many cases have been redesigned by the rubber manufacturer. They now incorporate mechanical mold-handling equipment, hydraulic push-downs, automatic bumping devices, mechanical mandrel or insert-ejector devices, and the like, which provide means for more accurate and more economical mold-handling, Fig. 6.

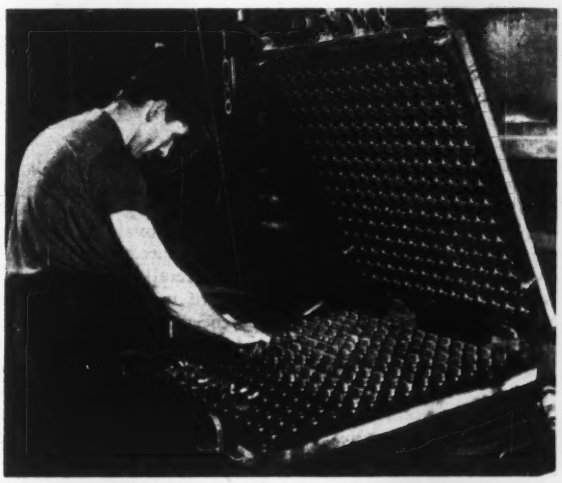


FIG. 4 CONVENTIONAL MOLDING OF SMALL PARTS

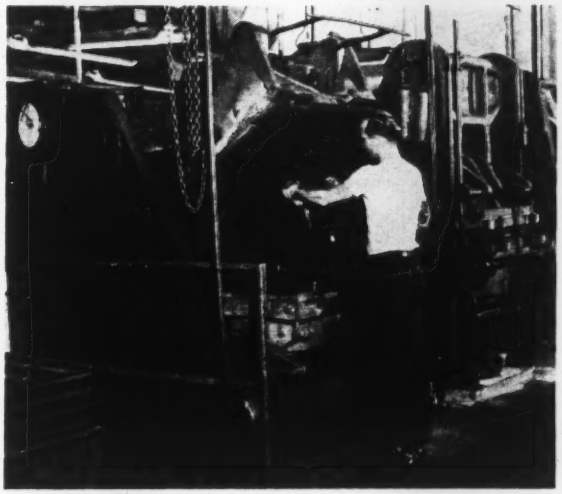


FIG. 5 AUTOMATIC MECHANICAL-TYPE PRESSES

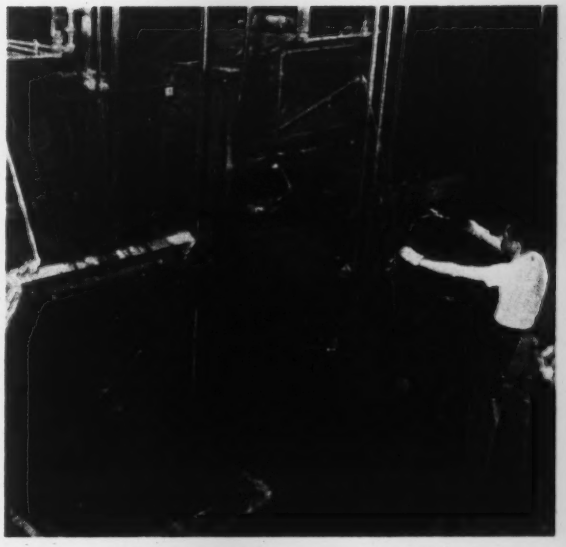


FIG. 6 AUTOMATIC HYDRAULIC-TYPE PRESSES

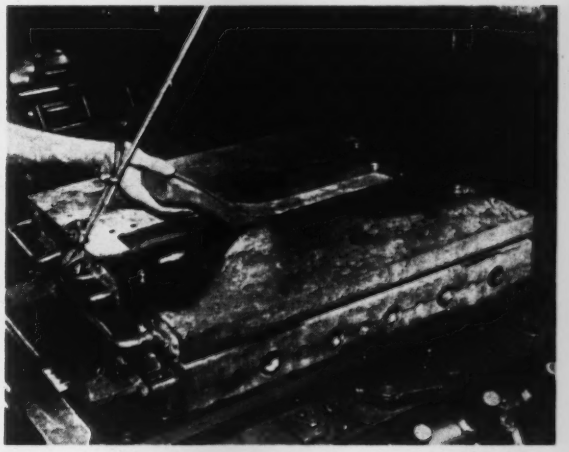


FIG. 7 TRANSFER-TYPE MOLD BEING LOADED WITH UNCURED COMPOUND

In like manner, compression molds should be made sufficiently strong to withstand higher molding pressures and accurately machined to give the dimensional tolerances required for the product. The complexity of many of the molded products in use today has resulted in the use of complicated and exacting molds. The use of precision-cast or hobbed cavities, permanent magnets to hold metal inserts in place, loose drop-type inserts integral with the mold to eliminate handling, and cavity layout to facilitate strip-loading are some of the refinements promoting better manufacturing operations.

Transfer and Injection-Molding. Rubber forced from a central pot through sprues into mold cavities provides an efficient method of producing many types of products impractical to compression mold. This method of transfer-molding, adapted to conventional hydraulic presses, allows a variable injection and mold-clamping pressure (Fig. 7). It generally results in

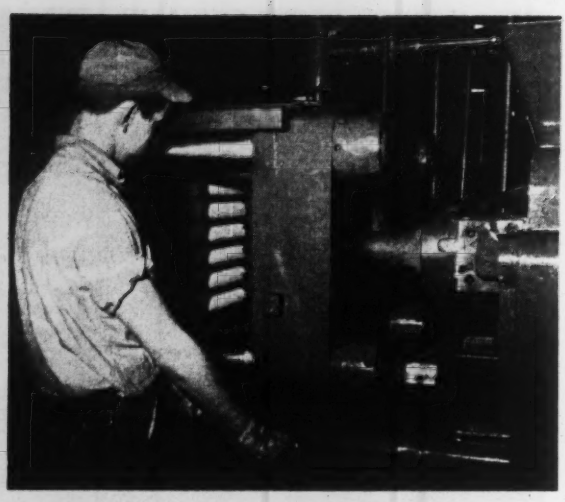


FIG. 8 SCREW-TYPE INJECTION PRESS

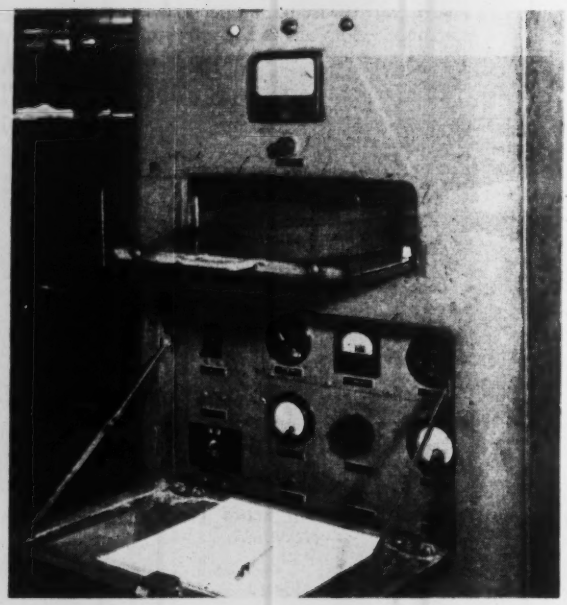


FIG. 9 DIELECTRIC PREHEATING OF UNCURED RUBBER

lower mold maintenance since the mold is closed completely and registered at the beginning of the molding cycle. The variable injection pressure permits the molding of parts with no, or extremely thin, flash.

Injection machines utilize a screw mechanism to force unvulcanized rubber into a tightly closed mold, Fig. 8 Forcing the rubber through small passages under high pressure increases the temperature of the injected compound sufficiently to reduce curing time considerably.

Because of the low thermal conductivity of rubber, thick products heated from the surface only require long curing times at relatively low temperature. Curing such products at the usual temperatures and for a time long enough to obtain complete cure in the center often results in serious overcuring at the surfaces. Another disadvantage of normal temperature curing of thick products is a tendency to back rind at the mold parting line. Dielectric heating (Fig. 9) of the rubber before placing it in the mold helps to overcome these difficulties. This process reduces curing time, increases mold turnover, and reduces the number of certain types of rejects. The principal advantages of this method are faster and more uniform heating since the preform actually becomes slightly hotter in the center than on the outside.

The principle of dielectric heating is rather simple, though the equipment necessary for heating is relatively complicated. When a voltage is applied to a nonconductor in a condenser, the molecules are distorted and if the voltage is alternating, they will tend to oscillate, thus dissipating energy and causing a rise in temperature. The amount of oscillation is dependent on the voltage applied. By applying a high voltage to the material to be heated, and rapidly reversing the potential on the condenser (usually from 1,000,000 to 35,000,000 times per sec in the case of rubber) a considerable temperature increase can be obtained. Since the temperature rise is nearly uniform throughout the material this method is especially effective in preheating relatively thick rubber.

This method of heating also can be used to soften rubber or rubberlike materials, permitting easier mold flow or easier injection in the case of transfer-molding. In all cases, however, the relative production costs must be studied to see if its use is justified economically.

FINISHING PROCESSES

The amount of flash or overflow that extends from the cured product when it is taken from the mold varies greatly with the type of molding method used. As flash removal is often one of the most costly operations in the manufacture of a molded-rubber product, it is always considered carefully, both as to the method of removal and the means of molding which will minimize the amount of flash. Furthermore, the requirements of the product and the product's function are taken into consideration to determine the allowable flash extension on finished parts.

When applicable, cold temperature tumbling, Fig. 10 (dry ice or liquid carbon dioxide) provides one of the most satisfactory and economical means of flash removal. The part is frozen rigid and the tumbling action breaks off the brittle thin flash extensions. There are some limitations of this process which

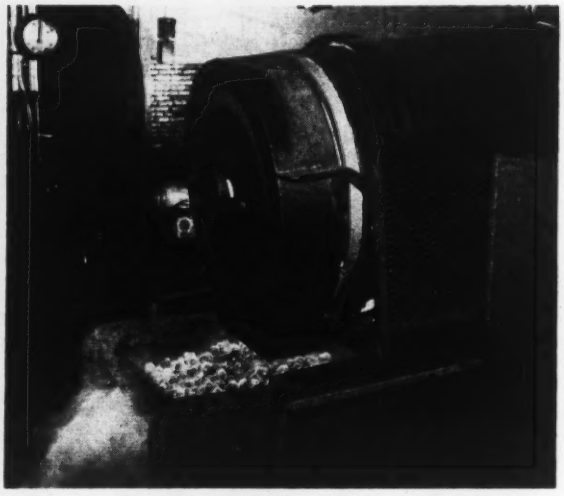


FIG. 10 COLD TEMPERATURE TUMBLING

FIG. 11 MULTISPINDLE REAMING OF BATTERY CASE

result from (1) flash thicknesses which are too great to break off completely, (2) the use of rubber compounds which do not freeze rigidly, and (3) parts of such design that the tumbling or freezing action will cause excessive defective product.

Mechanized punch presses, with single or multiple dies and with conventional or rotary loading mechanisms, provide an efficient method of trimming where flash thicknesses are relatively great, where entire mold loads are removed in a single sheet, or where holes or notches are to be put in the product.

Wire-brushing by hand with conventional pedestal buffers is commonly used for removing flash from molded-to-metal parts. Automatic wire buffing, multiple-spindle reaming, Fig 11, and other specialized types of mechanical equipment are utilized to remove flash from those products where large-volume production justifies their use.

Great stress is given to the flash-removal problem throughout product design, customer contact, manufacturing-process determination, mold design, and finishing-equipment design. Herein lies a problem which often affects product cost and appearance as much as, or more than, any other single consideration.

INSPECTION AND TESTING

The newer and frequently more rigid requirements imposed on molded-rubber products have resulted in the necessity of providing the means to inspect and test these parts properly to meet all the prescribed specifications.

The use of statistical quality-control methods to insure proper quality levels has been adopted for some molded-rubber products, but the use of these techniques has not yet proved to be economically sound for the over-all operations. However, despite the fact that these techniques have not been exploited completely from the finished product or operational standpoint, they are being used extensively as compound-batch controls and in-process inspection.

The system of 100 per cent inspection and test of finished rubber products is used universally throughout the industry (Fig. 12).

The inspection of a molded-rubber product may vary from the time necessary to pick up each item of any given lot for a quick visual inspection, in order to accept only those parts that are visibly satisfactory from an outward appearance, to the thorough inspection given an automotive vibration damper that is inspected as follows:

1 Check concentricity of bore of inner metal to OD of outer metal to TIR of 0.030 in.
2 Check bore of inner metal to plus or minus 0.002 in.
3 Check flatness of inner metal.
4 Inspect for proper relative torsional deflection between inertia member and case to meet deflection of 0.080—0.095 in. under 100 ft-lb load.

The following miscellaneous operations could be used to describe typical inspection procedures for the normal wide variety of molded-rubber products inspected.

1 Quick visual inspection only.
2 Close visual inspection, flex for adhesion and/or flow cracks or tears.
3 Close visual inspection, flex for flow cracks and/or gage as required.
4 Wash and inspect during washing, flex and/or gage.
5 Test for some specific functional characteristic, namely, adhesion, load-deflection rate, flow rate, sealing ability, hardness, and so on.

FIG. 12 100 PER CENT VISUAL INSPECTION

FIG. 13 STRETCH-TESTING PRESSURE-PIPE RUBBER RINGS

The testing operation, shown as item 5, could be elaborated further by referring to the actual inspection or testing performed on several specific typical molded-rubber products, such as the following:

Pressure-Pipe Rubber Rings. Place ring on expansion pulleys and stretch each part to 100 per cent of original circumference and visually inspect for irregular surface depressions, pits, cracks, blisters, porosity, air pockets, and necking, Fig. 13. Revolve ring on pulleys to permit inspection of complete surface.

Automotive-Engine Mounts:

(*a*) Inspect for hardness.
(*b*) Flex mounts twice under 350-lb compressive load and check load-deflection rate to plus or minus 10 per cent for 350-lb load at 0.062-in. deflection, Fig. 14.
(*c*) Test for adhesion.
(*d*) Gage free height to print tolerances.

Hydraulic-Brake Check-Valve Seat. Place molded-rubber valve seat over orifice in smooth plate and inspect for air leaks through water under 2-in. vacuum.

Tractor-Seat Torsional Spring:

(*a*) Check 100 per cent of pieces for adhesion in special testing machine, by flexing 220 deg in torsion and allowing free axial movement during test.
(*b*) Stamp inspector's number on each piece for certification.

Safety-Tube Valve Stem:

(*a*) Inspect for obvious surface defects and cracks and flex for adhesion.
(*b*) Gage base hole with 0.090–0.095-in. plug gage.
(*c*) Gage side hole with 0.049–0.051-in. plug gage.
(*d*) Test on flowmeter for correct air flow of 25 plus or minus 5 cfh.

Random-sampling proceedings include periodic product dimensional checks to insure proper mold register and cavity contours. Quality checks are made to insure the use of proper load-deflection rate, adhesion, oil resistance, and so on. Continuous tests are made to insure proper product performance under actual service or accelerated service conditions, for example, drum tests on farm-implement tires, flex tests on air-brake diaphragms (Fig. 15), belt tests on wringer rolls, and fatigue-life tests on automotive-engine mounts.

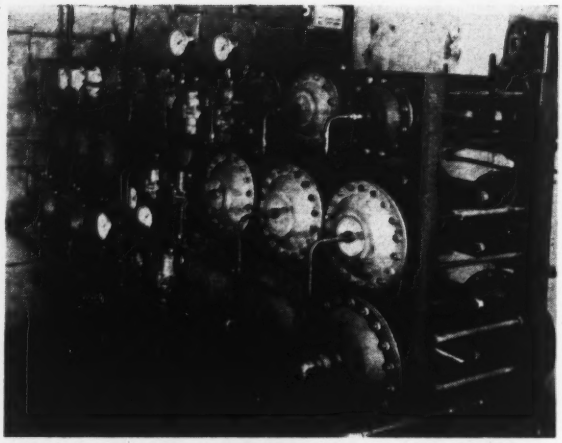


FIG. 15 FLEX-TESTING AIR-BRAKE DIAPHRAGMS

Dynamic test machines are being used to make quality-control checks on production lots of automotive-engine mounts. The Sonntag SF1U fatigue-life tester is a machine suitable for performing these tests as a rapid quality check.

CONCLUSION

Molded-rubber and rubber-and-metal products are being produced in large volume at relatively low costs to close tolerances and with wide varieties of compound characteristics. The use of molded-rubber products as functional parts in all industrial fields, plus the development of varied specialized machinery and techniques used exclusively for manufacturing molded products, has made molded rubber a separate division of the rubber industry.

Rubber-equipment manufacturers have developed and are producing special machinery for manufacturing molded products, and the rubber manufacturers individually have developed many special process machines for all phases of preparation, curing, finishing, and inspection operations.

FIG. 14 LOAD-DEFLECTION RATE TESTING AUTOMOTIVE-ENGINE MOUNTS

POLYTETRAFLUOROETHYLENE —ITS PROPERTIES *and* USES

By L. W. CORNELL

MINNESOTA MINING & MANUFACTURING COMPANY, ST. PAUL, MINN.

INTRODUCTION

TEFLON[1] is the trade name for a comparatively new polymeric resin with unique properties, which is composed of tetrafluoroethylene, C_2F_4. The basic polymer is made and sold only by the du Pont Company, but a number of other companies process and sell Teflon in different forms for the ultimate consumer. Because of the fact that there is only one manufacturer of this material at present, it will be called by its trade name which is much simpler than its chemical name.

PROPERTIES AND USES

Electrical. Teflon is an excellent electrical insulator for many purposes, particularly where high-temperature conditions must be met. It may be used at temperatures as high as 500 F in continuous service and withstands intermittent exposure to 600 F. It also retains its flexibility and electrical properties as low as minus 100 F. A detailed list of electrical properties is given in Table 1. Its uniform dielectric constant and power factor over an extremely wide frequency range make Teflon very useful in many electrical applications. Its extremely broad temperature range enables it to be used in applications where other less expensive materials would not be suitable. There is increasing demand for Teflon-insulated wire and cable in jet aircraft, for example. Guided missiles are another application where Teflon is being used, again because of the temperature range encountered.

TABLE 1 ELECTRICAL PROPERTIES OF TEFLON

Property	Conditions	Units	Value	Test method
Dielectric strength, short time	0.080 in.	volts/mil	400–500[a]	D149-44
Surface arc resistance	...	seconds	700[b]	D495-42
Volume resistivity	...	ohms-cm	10^{18}	D257-46
Surface resistivity	100% RH	megohms	3.6×10^{6}	D257-46
Dielectric constant	60 cycles	...	2.0	D150-47T
Dielectric constant	10^{8} cycles	...	2.0	D150-47T
Power factor	60 cycles	...	0.0005	D150-47T
Power factor	10^{8} cycles	...	0.0005	D150-47T

[a] Much higher in thinner film, see Table 2.
[b] Leaves no carbonized track.

Aircraft motors and generators can be made smaller and more powerful with Teflon as slot liners, and so on. Coils and relays which must operate continuously at high temperatures use interlayer insulation of Teflon and Teflon-insulated magnet wire in the coils themselves.

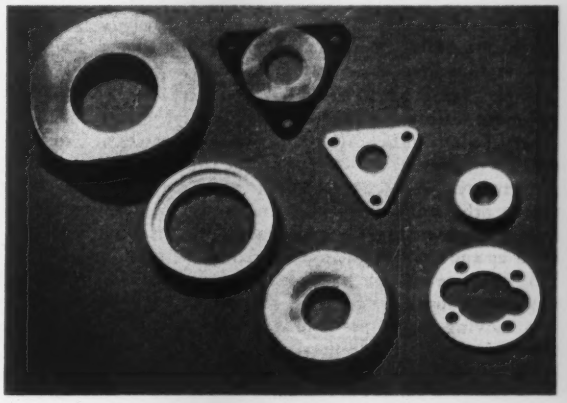
High-temperature-resistant capacitors are now being manufactured with Teflon sheet insulation instead of paper or other material. The plastic is being molded into tube sockets for radio and radar components for aircraft. Insulating spacers for coaxial cable are being molded of Teflon.

In all these electrical applications and in many others, Teflon is being used in spite of its high cost because temperature requirements are being pushed further in both directions all the time. Teflon combines toughness, abrasion resistance, chemical resistance, excellent electrical properties, and high and low-temperature resistance in one material.

Chemical. Chemically, Teflon is about as inert as glass within its useful temperature range. It is attacked by molten alkali metals (sodium or potassium) and by fluorine and chlorine trifluoride, both at high temperatures and pressures. Other than these specific chemicals, published literature indicates that nothing has any effect on Teflon. This makes it ideal as a gasket material and liner in equipment in which high-temperature highly corrosive chemicals must be handled. Since there is no known solvent for Teflon, it can be used in contact with any ordinary solvent without effect. Outside weathering also has no effect on Teflon. Samples exposed to natural aging for 5 years in Florida have shown no change.

In large stainless-steel or glass-lined equipment, many gaskets are needed, some of them quite large. The main body of the gaskets used on such equipment is generally made of asbestos, lead, rubber, cloth, or a combination of these materials, in order to provide the desired physical characteristics of compressibility, and so on. These materials must be protected from the action of the chemicals inside the equipment, and this is now commonly done by the use of a Teflon shield which is shaped to cover the top and bottom faces and the inside edge. Such gasket shields vary in size from a little over 1 in. ID to 5 ft ID.

Teflon is expected to find application as liners or bladders in connection with containers for white and red fuming nitric acid, when certain fabrication problems have been solved. Here, its ability to give chemical protection in thin flexible



GASKETS MADE OF TEFLON

[1] "Teflon" is a registered trade-mark of E. I. du Pont de Nemours & Company, Inc.

Contributed by the Rubber and Plastics Division and presented at the Spring Meeting, Columbus, Ohio, April 28–30, 1953, of The American Society of Mechanical Engineers.

sheets is an important factor. Already it has proved its ability to withstand nitric and sulphuric-acid mixtures in actual use as gaskets on equipment handling these acids at about 400 F. Teflon gaskets gave 18 months' service in comparison with 1 month for asbestos. This points up something of importance in connection with Teflon. In spite of its high price, it is frequently selected because no other known material can do the job. However, in many cases, such as the gasket just mentioned, Teflon actually may be cheaper in the long run because of the greatly increased service which it gives. In the gasket, valve, and diaphragm field, Teflon, in certain applications, is economically replacing such materials as asbestos, specialty rubbers, bronze, cast iron, and other materials.

Molded Teflon tubing with fairly thick walls is available for chemical work. Also, one company is producing large-sized pipe with relatively thin tough walls from a combination of glass cloth and Teflon. Small-diameter pure-Teflon tubing with very low wall thickness (as low as 0.005 in.) can be produced from a special form of Teflon film which has become available recently. This film will be described in detail under methods of fabricating Teflon and the forms in which it is available. The various types of Teflon tubing should broaden its use in the chemical-processing industry.

Physical and Mechanical. The high-temperature resistance of Teflon has been mentioned already. Its mechanical properties are very stable up to 500 F. For example, molded bars held at 480 F for 1 month show a loss of only 1 per cent in tensile strength. At 570 F the loss is 10 to 20 per cent. In addition to its high-temperature resistance it is serviceable to minus 100 F, and, in fact, instances of its use at temperatures as low as minus 320 F have been reported.

The plastic absorbs no water at all, and therefore its electrical, physical, mechanical, and chemical properties are unaffected by soaking in water, or by exposure to high-humidity atmosphere.

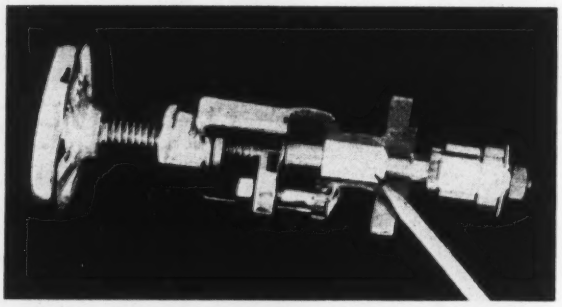
One of the most interesting properties of Teflon is its nonadhesiveness or slipperiness. This property has proved to be useful in many applications in the industrial field. For example, one large coating machine was giving a great deal of trouble with dirtying up of idler rolls in the oven on a certain coating job which was performed at intervals. The problem was solved by spiral-wrapping wide Teflon film around the roll, taping it down at each end of the roll. When the operation was finished the Teflon film was unwound and stored until it was needed again.

The baking industry has found that Teflon finishes can solve many of their problems. Cookie rolls, which carry a series of depressions into which dough is rolled to shape the cookie, have been coated with Teflon to prevent sticking of the dough and damage to the cookies. Rollers which shape bread dough into balls can be kept from sticking to the dough by applying a Teflon covering.

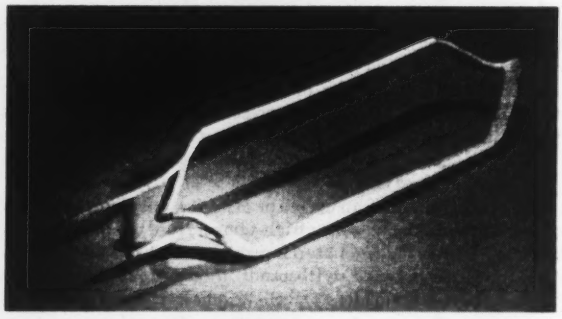
In packaging machinery, Teflon is very helpful. In heat sealers for sealing cellophane, foil, polyethylene, and the like, a liner of Teflon on the sealing shoes which contact the film being sealed will prevent its sticking to the shoe at the high sealing temperature. Also, in automatic packaging machines using glue or other adhesives, Teflon-coated rolls and fingers greatly reduce stoppages due to clogging of the machine with glue build-up and simplify the job of keeping the machine clean.

At least one instance has been reported in which it was found necessary to use a washer of $^1/_{32}$-in-thick Teflon sheet between two moving metal parts in a small machine. The Teflon washer was the only means of eliminating squeaking and grinding between the metal faces. All other available plastics were tried, but only Teflon did the job.

Certain parts of pumps and valves used in highly corrosive



TEFLON VALVE PACKING FOR USE IN CHEMICAL EQUIPMENT
(Valve by Alloy Steel Products Company.)



TEFLON TETRAFLUOROETHYLENE-RESIN TAPE USED FOR INSULATION IN MOTORS, GENERATORS, AND CONDUCTORS

service are being fabricated from Teflon. It can be molded, ground, and machined.

Teflon has rather poor heat conductivity and high thermal expansion. These points must be remembered in considering the use of the plastic as a packing around a pump shaft which will operate over a wide temperature range. Work has been done in adapting Teflon in sheet form for diaphragms in pumps, controllers, and the like. Teflon can be of value, for example, where a flexible and corrosion-proof diaphragm is needed, which does not, however, have to withstand rapid and extreme flexing. A detailed list of physical and mechanical properties is given in Table 4.

FORMS OF TEFLON AVAILABLE

Molding Powder. This is one of the basic forms of Teflon sold by du Pont. It is a granular form which is used for making heavy sheet, molded shapes, and like products.

Molded Pieces. Sheets $^1/_{16}$ in. thick or heavier as well as heavy-walled tubing, rods, bars, special shapes, and so on, are available from several companies which are set up to make and sell Teflon in such molded pieces. In this grouping there should be included molded gaskets, valve packings, valve seats, and the like. Also, at least one company can supply molded Teflon with copper or other metal firmly bonded to one face. Because of Teflon's high heat resistance, solder can be applied directly to the metal sheath.

Suspensoid. This is another basic form of Teflon resin. Particle size is much smaller than in molding powder. It is used for casting films, roll coating, spray coating, and the like.

Wire Enamels. These are suspensoids which have been specially processed for use in wire coating for the electrical industry.

Metal Primer. Du Pont produces three primers, one for copper, one for aluminum, and one for iron or other metals. They

give improved anchorage of Teflon coatings to these metals.

Lubricated Paste. This is a specially prepared form which can be extruded for certain applications. It is made from coagulated dispersion.

Shaved Film. A log or bar is molded from a special molding powder. Film in various calipers as low as 2 mils is shaved from the circumference of this log. This shaved film is satisfactory for many applications where low pinhole count is not important. It is not oriented or tensilized to any extent.

Extruded Film. This is made by a special process from the lubricated paste mentioned previously. Extruded film is highly oriented and possesses greatly increased tensile strength in the machine direction. It also contains very few pinholes. It is currently available in calipers from 2 to 20 mils and has been made in higher calipers on special order.

Two forms of extruded film are available, i.e., the regular transparent variety, and the new self-fusing form mentioned in connection with thin-walled small-diameter Teflon tubing.

Transparent Extruded Film. This form of Teflon film is fully fused and is used in a wide variety of applications, including motor-slot liner, cable wrapping, capacitor dielectric, coil wrapping, gasket shielding for corrosive chemicals, and so on. It is a highly transparent, smooth-surfaced film with remarkably low pinhole count. Its dielectric strength runs as high as 2500–3000 volts per mil in 2 to 5-mil-caliper film. Typical electrical and physical properties for transparent extruded Teflon film are shown in Table 2.

TABLE 2 PROPERTIES OF 5-MIL EXTRUDED TRANSPARENT TEFLON FILM

Property	Conditions	Units	Value	Test method
Dielectric strength, short time	...	volts/mil	2500	D149-44
Tensile strength:				
Longitudinal	77 F	psi	7000	D638-46T
Transverse	77 F	psi	2500	D638-46T

NOTE: Other values are essentially the same as in Tables 1 and 4.

Self-Fusing Extruded Film. This film is one of the newest forms of pure Teflon available and promises to extend the usefulness of the plastic a great deal. It is white and opaque and has much greater stretch and conformability than any of the regular transparent fused types. Its physical properties, as shown in Table 3, are quite different from those of the other types. It is seldom used in its unfused form, mainly because it is too soft and can be cut or abraded too easily. Its value lies in the fact that it does not slide too easily before fusion and that it bonds firmly to itself when fused in contact. Therefore it can be wrapped around articles which must be insulated electrically, or which must be protected from chemicals, and then fused in place to give a tough continuous Teflon covering. Because of its softness and pliability, it conforms well to various shapes around which it is wrapped. Of course, this sheet Teflon can be fused only onto metal or other material which can stand the high fusing temperature.

TABLE 3 PROPERTIES OF 5-MIL SELF-FUSING TEFLON FILM

Property	Conditions	Units	Value	Test method
Dielectric strength, short time	...	volts/mil	750	D149-44
Dielectric constant	60 cycles	...	1.7	D150-45T
Dielectric constant	10^8 cycles	...	1.7	D150-45T
Power factor	60 cycles	...	0.005	D150-45T
Power factor	10^8 cycles	...	0.005	D150-45T
Tensile strength:				
Longitudinal	77 F	psi	1300	D638-46T
Transverse	77 F	psi	160	D638-46T
Elongation:				
Longitudinal	77 F	per cent	175	D638-46T
Transverse	77 F	per cent	500	D638-46T
Density			1.4–1.5	

NOTE: After fusion, values for this film are similar to those for extruded transparent film.

Cast Film. This film is cast in multiple steps from Teflon suspensoid. It is of very good quality and very expensive compared with other available Teflon films. Maximum caliper of cast film at present is 2 mils, but it is available as low as $^1/_4$ mil. Like shaved film, cast film is not oriented or tensilized.

Teflon Pressure-Sensitive Tape. Pressure-sensitive Teflon-film-backed tapes have been made in combination with glass cloth. The adhesive used is one which vaporizes more or less completely at the maximum temperature to which the Teflon might be subjected in service, leaving little or no carbon residue. The pressure-sensitive adhesive simplifies the job of holding the Teflon in place during fabrication.

Surface Treatments. Recent work has produced Teflon sheet with very thin metal or other coatings or with surface characteristics different from those of regular Teflon so that better adhesion can be obtained to one side with conventional adhesives.

METHODS OF FABRICATION

In order to develop the inherent toughness and strength of Teflon, it must be fused or sintered above its transition tempera-

SAMPLES OF TUBING MADE BY SPIRAL-WRAPPING SELF-FUSING EXTRUDED TEFLON FILM AND SINTERING

TABLE 4 PHYSICAL AND MECHANICAL PROPERTIES OF TEFLON

Property	Conditions	Units	Value	Test method
Tensile strength	77 F	psi	1500–2500[a]	D638-46T
Elongation	77 F	per cent	100–200	D638-46T
Flexural strength	77 F	psi	Did not break	D790-45T
Stiffness	77 F	psi	60000	D790-45T
Impact strength:				
Izod	−70 F	ft-lb/in.	2.0	D256-47T
Izod	77 F	ft-lb/in.	4.0	D256-47T
Izod	170 F	ft-lb/in.	6.0	D256-47T
Hardness-durometer	...	...	D55–D70	D676-47T
Compressive stress	0.1% deformation	psi	1700	D695-44T
Coefficient of linear thermal expansion	77–140 F	per deg	5.5×10^{-5}	D696-44
Thermal conductivity	...	Btu/hr/-sq ft/-deg F/in.	1.7	[b]
Specific heat	...	Btu/lb/-deg F	0.25	...
Deformation under load	122 F–85 hr –1200 psi	per cent	4–8	D621-48T
Heat distortion temp	66 psi	deg F	270	D648B-45T
Water absorption	...	per cent	0	D570-42
Specific gravity	...	...	2.1–2.3	D792-48T

[a] Higher for oriented film, see Table 2.
[b] Measured by Cenco-Fitch apparatus.

ture of 621 F. At this temperature Teflon changes from a fairly hard, semitransparent, waxy solid to a rather soft, amorphous, transparent gel. This change occurs at 621 F whether the Teflon has been sintered previously or not. Before this sintering is done the first time, Teflon is not suitable for most operations.

The manufacture of molded Teflon articles or shapes is best done by a company which is set up to handle this type of work.

The various types of dispersions may be applied by spray gun or by dipping. They must then be dried and sintered at about 750 F. Successive coats are required to eliminate pinholes and give good chemical protection, and each coat should be fused separately. Further information on types of Teflon finishes available and their use may be obtained from the Finishes Division of du Pont.

Tapes can be used as a spiral wrap, which is done frequently for electrical insulation. For chemical protection, however, the self-adhering type which must be sintered after wrapping offers a better means of securing sealed protection.

The white, self-fusing Teflon sheet is easy to apply and to fuse around small shapes of regular surface, the simplest of which is ordinary copper wire. Here a simple spiral wrap with perhaps one-half overlap will give excellent results. Wrapped wire can be fused continuously by passing through a suitable oven maintained at 750 to 850 F, or even much higher if the wire is quite small. Wire speed depends on its size. It is well to quench the fused wire in water as soon as it comes from the oven.

The self-fusing Teflon may be applied over a wide variety of sizes and shapes, but special care is frequently required to insure fusion without crack formation. Wide sheets of Teflon have been made from the self-fusing type by overlapping at the edges over a suitable metal form and fusing while holding the film under tension.

Thin Teflon sheets can be well bonded to metal, even on a flat face, by using the proper Teflon primer for metal and fusing this film against it with pressure.

Technical help frequently may be needed from the supplier in working out applications for this self-fusing type of Teflon film.

Toxicology. A recent Technical Information Bulletin on Teflon from du Pont states the following:

"Minute amounts of gaseous fluorine compounds are given off at temperatures above 390 F and appreciable quantities are given off at 600 F or above. At approximately 750 F, polytetrafluoroethylene decomposes slowly. Adequate ventilation must be provided for any operation where these temperatures may be attained, because of possible toxicity of these gases."

SINTERED EXTRUDED TEFLON FILM

COST REDUCTION *Through* *Electronic* PRODUCTION CONTROL[1]

By R. G. CANNING[2]

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OF the four main aspects of cost reduction that come to mind probably the most common is that of product improvement; redesign of the product to simplify or eliminate parts, making for easier fabrication, and so on. The second aspect is methods improvement, a familiar subject to those in Industrial Engineering; this calls for more efficient use of tools, work space, motions, and the like. The third aspect is better utilization of productive facilities; this includes production planning, loading, and scheduling, and covers more efficient decision-making and more effective control. The last aspect is reduction of overhead, by the mechanization of the office.

In a current paper, Dr. M. E. Salveson[3] indicates a mathematical framework for the loading and scheduling of productive facilities. The development of such a mathematical model is most important, because it would provide production management with a systematic means of determining optimum (or near optimum) loads and schedules. The application of mathematical methods in practical situations undoubtedly will depend to a great extent upon the use of electronic data-processing equipment. However, the introduction of such electronic equipment also can result in the reduction of overhead by the mechanization of the office, if an adequate systems design is considered from the outset.

The main points made in this paper are that, in the author's opinion, the primary value of electronic production control for cost reduction will be in the form of increased output of product, using the same productive facilities (although it is realized that this "intangible" gain is often harder to sell to management); then to a lesser extent electronics also will reduce overhead, by replacing clerical employees.

To give a clearer picture of how these cost reductions might come about and why the two points are so rated, a sketch of an electronic system designed for one local company that shows promise of meeting these objectives, and an order of magnitude of these two types of cost savings, will be presented.

MECHANIZATION OF THE OFFICE

For logical sequence of presentation, it will be necessary to consider the latter of these two points, the mechanization of the office, as background material for the first point. One of the major objectives of the project, as set forth by Dr. Salveson,[4] is the design of a master scheduling computer which will fulfill the functions of loading and scheduling production operations. In attacking the problem of how to design such a machine, it was apparent that a data-handling system would be necessary for two functions: (*a*) to translate the schedule generated by this master computer into specific shop instructions, and (*b*) to measure and feed back the actual rate of progress, as initial conditions for the next scheduling computation. The present state of the electronic-computer art is such that a data system to perform these functions appears quite feasible even though the design of the master scheduling computer may not be as yet. Furthermore, a data system might well pay for itself in a short time by means of savings in clerical salaries, and thus pave the way for the introduction of the master scheduling computer at a later time.

To investigate this application of electronic machines to production data processing, a two-phase study was planned. The first phase was to consist of a number of plant visits to companies in the Los Angeles area to determine some of the characteristics of those firms which might be interested in electronic data systems, i.e., number of employees, type of product, type of production organization, and so on. The second phase was to locate one firm in the local area that met many of these requirements and study it in detail, with the aim of designing an electronic system to meet its needs. Thus we started out with one objective in mind of "mechanizing the production-control office"—we wanted to find out where employees could be replaced more efficiently by electronic machines, and an indication of how many employees could be so replaced.

The remainder of the paper will be devoted to presenting some of the conclusions of this two-phase study, with respect to cost reduction. Based on the results of the first phase of the study, we will first split the field of production control into two main segments, and choose one of them for analysis; within this segment, we will point out the types of firms most in need of electronic production-control systems. We will state briefly the present methods used by such companies and finally, by the example of the case study, we will show how electronics more nearly can provide what is desired in the way of a production-control system for these firms.

One main segment of the production field about which much has been written recently (especially with respect to its probable use of electronics) has been given the name of "automation"—automatic materials handling and automatic control of the continuous production line. The continuous line appears to be the objective of much of American industry, in order to achieve mass production and low unit cost. The use of electronics here would be that of control, to replace some production employees in the routine operations of meter-watching, switch-throwing, and so on. This is an important field and is receiving considerable attention today, not only by industrial engineers but also by electronic and servosystem engineers. However, in a continuous-line plant, a relatively large production-control staff is usually not needed. The main production problem is estimating the size of the market (rate of demand) and then adjusting the rate of production to meet this demand. The small number of clerical employees in the

[1] Industrial Logistics Research Project, Research Report No. 13.

[2] This paper was prepared while the author was under contract to the Office of Naval Research and working on the Industrial Logistics Research Project, University of California, Los Angeles, Calif.

[3] "A Computational Technique for the Scheduling Problem," by M. E. Salveson, presented at the Semi-Annual Meeting, Los Angeles, Calif., June 28–July 2, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[4] "On a Quantitative Method in Production Planning and Scheduling," by M. E. Salveson, *Econometrica*, vol. 20, October, 1952, pp. 554–590.

Contributed by the Management Division and presented at the Semi-Annual Meeting, Los Angeles, Calif., June 28–July 2, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

production-control office does not hold much hope for necessary cost savings in such firms.

APPLYING SYSTEM TO JOB-SHOP PRODUCTION

Rather, it is the other segment of the production field with which we will be concerned—the job-shop operation, stressing customer service rather than mass production, where a large variety of products is possible, and production is to customer order rather than to finished-goods inventory. These are the firms that do have a relatively large production-control department. The results of the first phase of the study can be stated briefly. It was evident that job-shop plants with less than 500 employees probably could not justify the purchase of an electronic production-control system; also, certain plants with over 1000 employees almost certainly could well consider the purchase of such a system. Firms with over 500 but less than 1000 employees varied in their need, and would require individual detailed analysis. It is at this size of plant (over 1000 employees) that the concept of "freedom of choice" at the foreman level becomes important.

As an illustration of this concept, the continuous-line plant obviously has little freedom of choice as to which job will be worked on next; the next job coming down the line will be the one. If the necessary materials do not arrive at the right place at the right time, the line stops and the general manager of the plant knows about it in a matter of minutes. At the other extreme, in the large job shop, there are any number of jobs waiting to be worked on in any department, and the foreman is faced with the task of choosing which sequence to work on them.

Other forms of this "freedom-of-choice" problem were encountered, including plants with a large volume of engineering changes (as in the aircraft firms), a complicated payroll structure where any one employee might work on as many as ten different wage rates during a week, and large-volume inventory control where it is difficult to pick up the individual disbursements easily.

In the course of these plant visits, one plant stood out above the others as an interesting one for a detailed study. At this company, the production-control manager had developed quite an efficient manual system of production control, by the use of centralized inventory control, a priority system based on due dates, control boards in each department showing the due dates of the jobs in that department, and so on. With about 1000 employees in the plant, there were only eight expediters (or about 0.8 per cent of the total employees), which compares very well with the 2 to 5 per cent figure reported in other plants. It was felt that if an electronic system could "compete" with the present manual system, this would augur well for the use of electronics in other plants.

The company produces on a job-shop basis—to customer order, rather than to finished-goods inventory. A large variety of products is possible, and individual customer specifications are common. Since the firm does much of the fabrication of component parts, and all of the assembly, this means that the loading and scheduling problems are present.

Now, restricting attention to this type of plant, let us assume that customer orders are received and processed. This processing calls for a fair amount of clerical effort—exploding bills of material, posting requirements, recapping requirements and comparing with inventory, deciding whether to enter an order (shop or purchase) to obtain the parts, preparing such an order, investigating the status of raw materials and ordering them if needed. Let us assume that several thousand such orders are in the plant or in the purchasing department at any one time. To make matters realistic, we will consider that some of these thousands of orders are behind schedule, owing to machine breakdown, tooling troubles, reworks, and so on. Finally, let us concentrate our attention on the production controller, or chief expediter, whose responsibility it is to co-ordinate activities so as to get all of the parts of one customer order into the assembly department at one time.

THE CHIEF EXPEDITER'S JOB

Under present methods, what are the activities of such a person? Obviously, there are too many orders in the shop for him to remember the status of all of them. So decentralization is used; expediters are assigned to groups of departments to watch the status of orders within those departments. One of the main functions of these expediters is to observe the "exceptions," e.g., orders behind schedule more than a certain amount, and either take corrective action themselves or report the matter to the chief expediter. The other important source of such "exception" data is from the assembly department, which informs the chief expediter that certain assemblies cannot be worked since they have parts missing.

Since there is no regular flow of work within the shop, it is next to impossible to predict how many shop orders will arrive in any given department during a day. Thus bottlenecks can and do develop overnight. When bottlenecks do occur, the decision must be made immediately whether to authorize overtime or send some of the jobs outside on a subcontract basis. The former course has its obvious drawbacks, while the latter course costs heavily in time, in order for bids to be requested, and received, tools and materials shipped to the outside firm, and so on. Life often becomes a continuing succession of "putting out fires" for production-control management.

WHAT ELECTRONICS OFFERS

What does electronics have to offer for such a situation, in so far as the mechanization of clerical functions is concerned? Fig. 1 is a flow diagram of the proposed method of processing customer orders at the company studied. The first operation is that of typing a standard sales order from the customer's

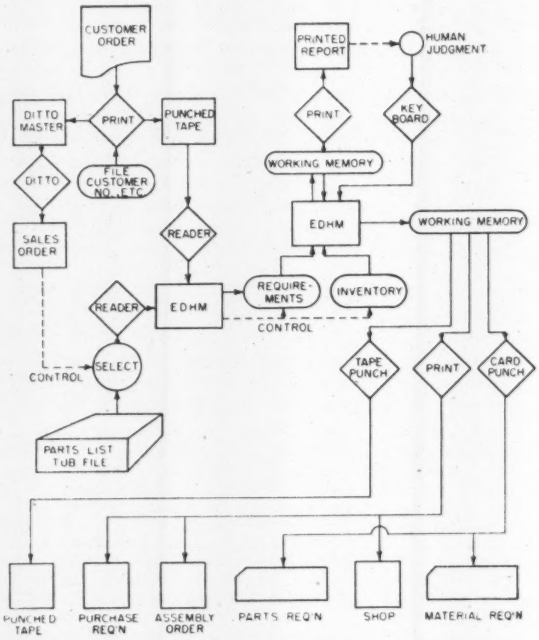


FIG. 1 POSTING REQUIREMENTS AND ORDERING

order. Such items as inspection procedure, renegotiation clause, customer code number, and product code must often be added to the information supplied by the customer. By using a special electric typewriter, a punched paper tape is obtained in addition to the regular typed document. This punched paper tape has the information in a form suitable for direct entry into an electronic data-handling machine. Bills of material are prepunched into punched cards (which are still important "building blocks" in a systems design, even with the advent of magnetic tapes, and the like). The appropriate decks are selected by the operator and fed into the machine. The machine combines these variable data (quantities, due dates, and so on) with the standard data and posts them on the requirements magnetic tape. After all postings are made, the machine scans the requirements for each part number, and compares it with the inventory data for the same part on the adjacent tape. Parts that may need ordering can be used for a "loading" computation described by Dr. Salveson, or the decision on what and how much to order can be made by the human operator after the machine prints out the facts on these questionable items. In addition to storing the order information inside the machine, we also ask the machine to prepare the customary papers to which we are accustomed and cannot live without.

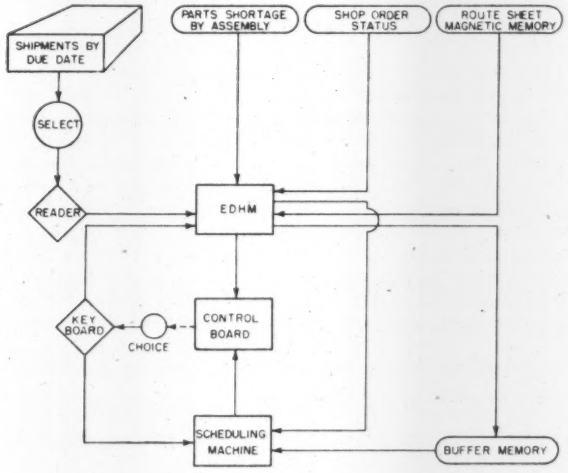


FIG. 2 CONTROL AND EXPEDITING

What has the machine done so far? Nothing that is not done already by manual methods, except that the operations of writing, computing, sorting, selecting, and so on, are done by machine instead of by clerks. As an important by-product, we have the pertinent information stored in the machine, where it can be used for other purposes. In much this same way, information on the progress of shop orders within the shop can be picked up and stored in the machine. Space does not permit a discussion of how this is accomplished in the system we propose, but further details may be obtained directly from the author or from a special report on the subject.[5]

Now, what does the production controller do with an electronic system? Fig. 2 is the block diagram of the analysis part of the proposed system.

To begin with, we see another tub file of punched cards; each card indicates a customer order for one month. If the customer enters an order for the same assembly over a period of several months, a similar card would be prepared for each month. These cards are then sorted and collated by shipment-due dates. As a first step in the analysis, the production controller selects the cards from the front of the deck; these cards represent shipments that are past due, due this week, and due during the next two weeks or so. These cards are then read into the electronic data-handling machine (EDHM).

HOW EDHM WORKS

For each card, the machine then automatically refers to one part of its memory, a magnetic tape showing how many parts are short for each assembly order. The information is presented graphically so that the production controller's attention is directed, for example, to those assembly orders that are past due and have only one part missing. It is on such critical parts that he will concentrate his attention. He then asks the machine to indicate the part numbers of these critical parts.

The next step is to find the present status of all shop orders that are making these critical parts. To do this, the machine automatically refers to another magnetic-tape memory (there being at least four such tape units tied to the machine, each storing the equivalent of 12,000 punched cards). After this step, the production controller is able to concentrate his attention on the critical shop orders.

Notice the difference between the present manual systems and the electronic system. In the manual systems, no one man can keep track of the status of all orders in the shop, so that this function is split up between a number of men. In the electronic system, the machine has all the information available and presents the desired information on demand to the production controller, for his decision. Except for this, however, the electronic system is still not too different from the present manual methods using clerical help. The system so far, then, is the mechanization of the office.

Perhaps the reader is questioning why we have mixed up punched cards with magnetic tapes—why not all one or the other? Punched cards are still very useful for the operations of printing, sorting, and collating data. Also, they constitute an economical and efficient form of data storage where sequential access from small decks of cards is sufficient and where few changes occur in the data; it is hard to "erase" a hole in a card, for example. Magnetic tapes, on the other hand, have the advantage of automatic look-up (called random access), ease of erasing and changing the data, and no need for the machine operator constantly to feed new decks of cards into the machine. It is likely that for some years to come, electronic data-processing systems will make use of both methods.

THE SCHEDULING PROBLEM

Now let us consider the scheduling problem—the anticipation of bottlenecks and the decisions on the most effective corrective actions needed. As was pointed out earlier, the large number of shop orders and other variables cause this to be a difficult decision-making problem for the production controller. Owing to the limited memory span of the human mind, the number of variables that enter into these decisions must be reduced to the point where one person can comprehend them.

Simplification of the manual scheduling operation is accomplished as follows: The main criterion of priority for a shop order is due date—primarily, the date on which it must be ready for the assembly department, and then the individual operation due dates which must be met in order to achieve the final due date. If the shop order is for parts that are holding up the completion of an assembly, a higher priority can be given by setting back the individual operation due date

[5] "A Proposed Electronic Data Handling System for Production Control," by R. G. Canning, Research Report No. 10, February, 1953, Industrial Logistics Research Project, University of California, Los Angeles, Calif.

until there is no other job in the department with an earlier date. However, if the co-ordination of several shop orders is involved, to make them all arrive at the assembly department at the same time, this is often too complicated a situation to solve mentally with any degree of accuracy, owing to all the interactions. The time estimate for a shop order to progress through several operations is not calculated from standard times plus waiting times, but is likely to be an average "flow time" based on experience. Thus "rules of thumb" must be used, and the expediters concentrate their attention on the "exception" orders.

It is in such a situation that electronics begins to show a marked advantage over manual methods. An important feature of the system is that very little additional equipment is needed for this function, since all the pertinent production data are stored already in the machine.

Referring again to Fig. 2, we have added a block called the scheduling machine. For those familiar with industrial engineering, this machine is an electronic analog of the well-known Gantt chart. For those not familiar with Gantt charts, let us say that the scheduling machine assigns shop orders to machine tools in just the same decision-making manner as is done in the shop—only on a much faster time scale. The machine is then able to deduce logically what is most likely to be happening in the shop for each hour during the next few weeks.

The scheduling machine is first loaded from the shop-order status tape, which gives an up-to-date picture of the status of each shop order. The machine then starts working its way into the future, hour by hour. When a machine tool is available, the scheduling machine scans through all waiting shop orders and picks the "one" with the highest priority that is slated to go on that type of machine tool. At any desired time, the machine can stop working its way into the future and total up the number of shop orders waiting in each department, to give a picture of scheduled versus available hours.

When a future bottleneck becomes apparent, the production controller has several choices, in order to smooth out the peaks and valleys: changing priorities to move some jobs faster, overtime work, sending certain jobs outside on subcontract well in advance of when the bottleneck would occur, and so on. By "playing" with the schedule in this way, it is believed that he can derive a satisfactory schedule for the next week or two. Also, he can get a rough idea of the future by letting the machine run out a month or two in advance. A rough estimate of the time scale is 15 min machine time for 40 hr shop time.

Therefore, two brief (and, it is hoped important) statements can be made about the contribution of electronics to the scheduling problem: The electronic machine helps the production controller to include more of the important variables into his decision-making process, instead of using simplifications and "rules of thumb." Also the scheduling machine allows the production controller to see the consequences of several alternative decisions, and to choose the decision with the better consequences. Bottlenecks and valleys can be foreseen and corrective action started in time to do some good. We feel confident that a better utilization of production facilities will be realized from such a system, with resultant savings even greater than those obtained from mechanization of clerical operations.

POSSIBLE COST REDUCTIONS

The question then arises—what is the magnitude of cost reductions that an electronic system might produce? Educated estimates only are available so far. At the company studied, it is estimated that the functions of about 14 of the 29 people now in production control could be handled by the machine. This direct saving from salaries and overhead would amount to some $175,000 or more, in $2\frac{1}{2}$ years. Since the company's product output in $2\frac{1}{2}$ years would be in the neighborhood of (and this is an estimate based on the number of direct labor employees) $12,000,000, even a 3 per cent increase in output from the reduction of bottlenecks and more optimum scheduling and loading would mean a saving of about $360,000, or about twice as much as the clerical savings. The two savings total some $535,000 in $2\frac{1}{2}$ years, and the cost of the equipment is estimated to be between $250,000 and $300,000.

CONCLUSION

This paper gives an idea of how an electronic system could take over many of the routine clerical operations in production control, and to assist in some of the nonroutine operations. However, space does not permit a discussion of some of the more interesting issues such as how a particular company can determine whether or not electronics would be of interest to the management. Nor has it been possible to consider the likely and very important reactions of employees, unions, supervisors, and top management to the idea of such a system, or the possible changes in a company's way of doing business. These are questions requiring further investigation as actual applications are made.

Aerosol Camera

AN EXPERIMENTAL camera for photographing microscopic particles floating free in the atmosphere has been announced by Stanford Research Institute, Palo Alto, Calif.

The Institute's news bulletin, "Research for Industry," describes the camera as being able to photograph aerosols (air-borne solid or liquid particles) as small as one two-thousandth of an inch.

Institute scientists are currently putting their aerosol camera through exhaustive tests. The pilot model will undergo continuous modification based upon operating experience.

According to Paul L. Magill, technical director of SRI's air research laboratories, the aerosol camera will give air researchers an opportunity to study aerosols in their natural state. Previous microscopic techniques have required collection of the particles on slides, he said.

When fully perfected, the 500-lb camera should indicate whether or not the process of settling or precipitating particles upon a slide alters or destroys some of them.

The camera's depth of field is 200 microns (a micron is $\frac{1}{25,000}$ in.).

Instead of a mechanical shutter, pulsed flashes of a narrow-beam light provide the film exposure. The flashes—of 2 million cp intensity—may be one, four, or ten microseconds duration, or from one millionth to ten millionths of a second.

The number of flashes may be regulated at any number up to 100 exposures per second. Approximately 15,000 volts are delivered to an air-cooled flash tube for the illumination.

In a "pea-soup" fog, scientists have counted up to 2000 aerosol particles per cubic inch. Since aerosols are constantly circulating, it is calculated that 12 exposures would be required to catch at least one particle.

A moderate fog would require 10 to 20 times as many exposures to be sure of finding an aerosol particle. The camera's design allows its operator to expose each 5 × 7-in. film as many times as desired.

SRI scientists have made as many as 6000 exposures on a single film without clouding or obscuring any image. Aerosols in the field of focus show up black.

The apparatus is portable and therefore adapted to field work wherever the air is to be studied.

Extending ENGINEERING SKILLS *With Large-Scale* DIGITAL COMPUTERS

By ALLEN KELLER[1]

GENERAL ELECTRIC COMPANY, LYNN, MASS. MEMBER ASME

INTRODUCTION

FOR a few years, punched-card machines have been used by several divisions in the author's company for solving various kinds of engineering problems. In the Turbine Division, for example, such machines have been used for calculating critical speeds of shafts, for evaluating stresses, for making theoretical fluid-flow studies, for scheduling drawing-office output, and for some other specialized jobs. Within the past few months, it has become apparent that card-programmed calculators are useful for solving a rather wide variety of such problems.

This paper deals with a different kind of computer, the large-scale computer of the "giant-brain" type in which all instructions as well as data are stored internally. The internal storage of orders gives the computer another degree of freedom in that a large number of different calculation procedures may be stored internally inside the computer and the computer, itself, instructed to select the applicable procedure for each specific calculation.

For several years, the author and his associates have been studying the application of large-scale computers to the solution of turbine design problems. During 1953, a modern, high-speed, high-capacity, electronic computer[2] will become available for the use of turbine engineers in the author's company. The computer will be located at Evendale, Ohio, in a jet-engine factory. Turbine engineers at Schenectady, N. Y., Lynn, Mass., and Fitchburg, Mass., will use the machine by sending their problems to Evendale for solution. Present plans are to use leased-wire facilities for transmitting numerical data between the different locations.

To most engineers and members of management the claims made for modern computers sound fantastic. This is so because most people, even the otherwise well informed, have little understanding as to how problems may be set up for solution on an automatic calculator. For example, much engineering data are empirical and expressed in graphical form. Without special input equipment, which is expensive and not generally available, digital computers cannot work with charts. Therefore, the reaction of the average engineer is, "A digital computer cannot possibly solve my problem. My data are mostly empirical and mathematical expressions do not exist for the functional relationships involved."

Much has been written on what computers can do; relatively little has been written on how they do it. The discussion which follows considers one specific repetitive engineering problem and shows how the problem may be organized for automatic computation. Following this, possible computer applications are reviewed and suggestions made for undertaking a study as to the value of automatic calculation in any particular case.

GENERAL DESCRIPTION OF A 1954 OR 1955 MODEL COMPUTER

It requires a year or more to build an organization for using a digital computer. Therefore, anyone not now using such a machine but contemplating the use of one should think in terms of what will be available in 1954 or 1955.

Following the pattern of every new development, early large-scale computers gave rise to the usual trials and tribulations. The time has now been reached, however, when it can be said that computers do, in fact, "compute." Of course, the reliability of different makes of computers varies and the performance of all makes will improve further, but many computers are now establishing records of error-free operation for a large proportion of their scheduled operating time.

In this paper it is assumed that computers are electronically and mechanically reliable. Many 1953 computers are "good" in this respect, and 1954 and 1955 models will be better. This point will not be discussed further.

It has been said that computers have improved 10 to 1 each year for the past few years. This would mean that they are now 1,000,000 times as good as 6 years ago. This may be somewhat of an exaggeration but does illustrate the extremely rapid tempo of new developments in the computing-machine field.

The following is a description of a computer about 10 times as good as present-day models with respect to computing speed and internal storage capacity. This description is given so the reader will have a clear idea of the general type of computer being considered:

1 Form of input and output "words": 10 decimal digits and/or alphabetical characters.

2 Computing speed: 100,000 ten-digit additions or subtractions per second. 20,000 ten-digit multiplications or divisions per second.

3 Internal storage capacity, 10,000 to 20,000 ten-digit numbers. (The program, i.e., sequence of individual operations, for solving a problem is stored internally as well as all numbers used in the problem.)

4 External storage capacity: Unlimited storage in a magnetic-tape library (1,000,000 or more ten-digit numbers available to the computer without human intervention.)

5 Machine errors: About one per billion operations.

6 Probable cost of the 1954 or 1955 model: $200,000 per year rental (including maintenance). $500,000 to $1,000,000 purchase price.

TYPICAL ENGINEERING PROBLEM FOR LARGE-SCALE DIGITAL COMPUTER

To illustrate how a complicated problem may be organized for automatic computation, an example has been chosen which will be unfamiliar to many readers. An understanding of the

[1] Supervisor, Turbine Advance and Development Engineering, Medium Steam Turbine, Generator and Gear Department.

[2] IBM-Type 701 Electronic Data Processing Machine.

Contributed by the Management Division and presented at the Management Conference, Detroit, Mich., April 15–16, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

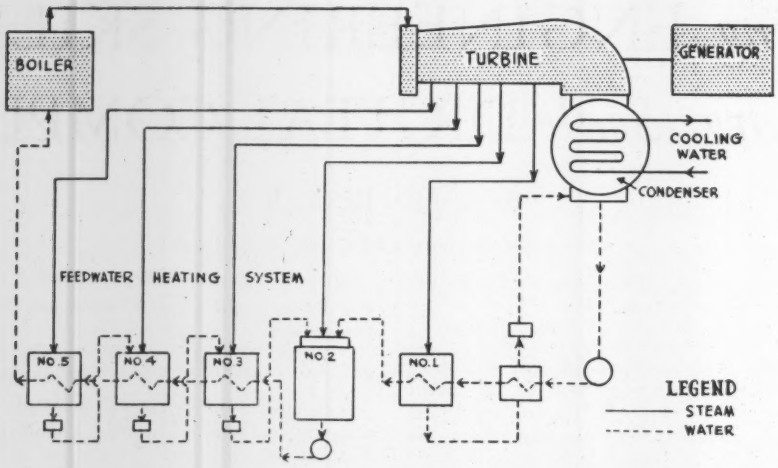


FIG. 1 HEAT-BALANCE DIAGRAM FOR PREFERRED STANDARD TURBINE-GENERATOR SET

details of the problem is not required, however, to appreciate how it may be solved.

Fig. 1 is a turbine heat-balance diagram. The mathematical problem is to calculate the steam and water flows at all points in the diagram when the generator is delivering a stated electrical output.

For economic and other reasons, a different diagram (number and arrangement of feedwater heaters) is generally specified for each turbine application. In fact, several diagrams are often studied for a single application to determine the most economical and practical arrangement of equipment. A limited number of persons in the author's company are kept busy making these calculations, and many more calculations would be useful if they could be made quickly and inexpensively.

CALCULATION OF A TURBINE HEAT BALANCE ON A DIGITAL COMPUTER

The calculation of a heat balance is generally considered to be a rather involved operation. The solution is a matter of trial and error. Even so, the problem can be systematized until it becomes a routine matter to solve on an automatic computer.

Although all heat-balance diagrams are different, they are all built up from the same standard components. Fig. 2 shows some of these components drawn on individual movable cards.

Fig. 3 shows the cards of Fig. 2 rearranged (and repeated when necessary) to form a picture which is the diagrammatic equivalent of Fig. 1. The numbers of the cards are 1-13-13-13-4-5-13-16-4-2. These numbers can be used to describe completely the diagram Fig. 1 to an engineer and, by proper programming, can be used to cause an automatic calculator to make calculations for the proper feedwater-heating components.

A survey has shown that with about 50 different kinds of cards, substantially all desired diagrams can be delineated easily and quickly, including the fine points concerning packing, drain piping, feed-pump efficiency, turbine state line shape, and so forth. This method of programming with cards might be called "pictorial programming."

Of course, the input data required for the solution of a particular heat balance will depend on the complexity of the diagram. Each pictorial programming card can have printed on its reverse side precise instructions as to the data which

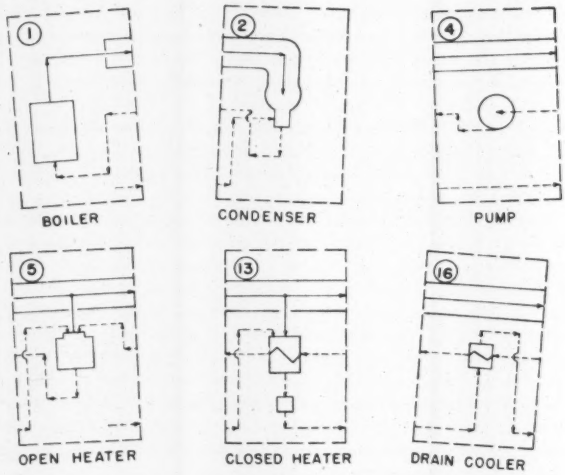


FIG. 2 COMPONENTS OF FEEDWATER-HEATING SYSTEM

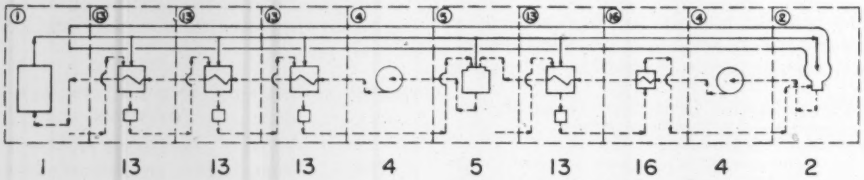


FIG. 3 "PICTORIAL PROGRAM" OF HEAT-BALANCE DIAGRAM OF FIG. 1

must be furnished the computer whenever that particular card is used.

By the foregoing means, the calculation of a heat balance becomes a routine matter:

1 Select the cards which delineate the diagram to be calculated.
2 Fill in the data called for on the reverse side of each card.
3 By keypunch, or its equivalent, convert the data on all cards into machine input.
4 Remove from the magnetic-tape library the program for calculating a heat balance and place it in the tape reader of the computer.
5 Push the "calculate" button on the computer control console.

After this, complete heat balances for a number of different loads and exhaust pressures should be forthcoming at the rate of one every few seconds. This should constitute an extension of engineering skills.

The foregoing shows how easily new heat-balance diagrams can be programmed for calculation after a suitable subprogram has been prepared and written on magnetic tape. A brief look at the organization of the calculation itself is now in order.

Fig. 4 shows a simplified feedwater-heating diagram. In this figure, all of the thermodynamic medium (steam or water)

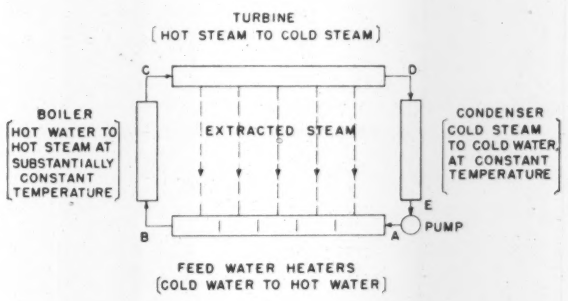


FIG. 4 SIMPLIFIED FEEDWATER-HEATING DIAGRAM

flows around the outside loop in a clockwise direction except the steam extracted for feedwater heating. An actual diagram is more complicated than Fig. 4, but the same general principle applies. A calculation may be started by making the initial assumption that all extraction flows are zero and that the flow around the loop, in pounds per hour, equals 8 times the desired generator output.* With these simple assumptions, first estimates can be calculated as to the actual flows required at all points in the diagram to generate the desired electrical output. The first estimates will be in error by 10 or 20 per cent in many cases; however, successive iterations of the entire calculation procedure will refine the accuracy of the estimates. After about five complete calculations, all flows will be within 0.01 per cent of their true values for the desired electrical output. With a speed of 20,000 to 100,000 operations per sec, each refinement of the answers will take about 1 sec. On this basis, an engineer cannot afford to spend any time making initial estimates of the extraction flows or even preparing a program for the computer to make good first estimates.

Now, a word about empirical data. A heat-balance calculation will require the use of many empirical functions, such as the properties of steam.

Table 1 shows a formulation for the enthalpy of superheated steam as a function of pressure and temperature. This formulation has a maximum deviation of 0.2 Btu/lb (about 2 parts in

TABLE 1 FORMULATION FOR ENTHALPY OF SUPERHEATED STEAM AS A FUNCTION OF PRESSURE AND TEMPERATURE

$$h = C_0 - C_1 p - C_2 p^2 - C_3 p^3$$

in which:

$$C_0 = 1062.8 + 0.4335t + 0.00003328t^2 + 0.000000003907t^3$$

$$C_1 = \frac{3579}{(t+10)^{1.7036}}$$

$$C_2 = \frac{7{,}774{,}500{,}000}{(t+20)^{5.26158}}$$

$$C_3 = \left\{ \begin{array}{l} +0.000002691742 \\ -0.000017295818\left[\frac{t}{1000}\right] \\ +0.000046260128\left[\frac{t}{1000}\right]^2 \\ -0.000065814610\left[\frac{t}{1000}\right]^3 \\ +0.000052468961\left[\frac{t}{1000}\right]^4 \\ -0.000022206250\left[\frac{t}{1000}\right]^5 \\ +0.000003895833\left[\frac{t}{1000}\right]^6 \end{array} \right.$$

Limits:

$$0 \leqslant p \leqslant 5000$$
$$t_{sat} \leqslant t \leqslant 1200$$
$$1.48 \leqslant s \leqslant 2.50$$

h = specific enthalpy, Btu/lb
p = pressure, psia
t = temperature, F
s = specific entropy, Btu/deg F/lb

15,000) from the steam table[3] over the entire superheated-steam region in which a turbine designer is normally interested. The author's organization now has formulations for substantially all the properties of steam and the other empirical functions required to calculate heat balances and to make several other types of thermodynamic calculations.

Supermen are not required to reduce empirical data to equation form, although imagination and originality are big helps. The formulation of Table 1 was derived in about 6 weeks' time by a college instructor[4] during summer employment with the author's company in 1952. Only slide rules and desk calculators were available for this work. Other formulations have been derived by half a dozen other people working independently at various times during the past 3 years. None of these persons had degrees above a bachelor's and they used three or four different methods of going about the work. In general, each person used a different technique, but all got results after considerable hard work.

THE GREAT VALUE OF COMPUTERS

From a business standpoint, the heat-balance problem cited can hardly justify $200,000 per year rental for a high-speed computer, although this one problem might justify one from

[3] "Thermodynamic Properties of Steam," by J. H. Keenan and F. G. Keyes, John Wiley & Sons, Inc., New York, N. Y., 1936.
[4] Robert M. Jodrey, Instructor, University of New Hampshire, Durham, N. H.

the standpoint of the over-all economy of the country, as will be seen shortly. Several such everyday problems collectively may justify a computer. The big justification for high-speed computers in turbine-design work will come, however, from such things as the improvement of turbine efficiencies by the application of aerodynamic theory to the determination of nozzle and bucket blade shapes. One per cent higher efficiency in one year's production of turbines by the author's company will save about $25,000,000 in fuel costs during the life of the turbines produced during that single year. If a computer can increase turbine efficiencies by 0.1 per cent per year, then it is economically worth $2,500,000 per year. On this basis, automatic calculation may well be economically sound for turbine heat balances alone, since as little as one or two hundredths of a per cent improvement in power-plant efficiency would save enough fuel to pay the entire cost of operating the computer for a full year.

A modern high-speed computer is costly to operate yet, on large operations, it may easily be worth many times what it costs. In aircraft-design work, for example, a computer may mean the difference between a successful and an unsuccessful plane.

PERSONNEL, THE CRUX OF THE COMPUTING-MACHINE PROBLEM

The author feels that each computing-machine application must be considered as a special case. This is so for the following reasons:

1 To lease or buy computing equipment requires a sizable outlay of money.

2 After a computer is available, each user, for the most part, must develop his own techniques for using the machine. This is true because the entire field of automatic computation is so new and the computing needs of different organizations are so varied that standardized procedures generally are not available at the present time for large problems.

From the foregoing, it is apparent that the crux of the computing-machine problem is personnel. Given a problem large enough to warrant automatic computation, a computing machine in the hands of competent personnel will be a distinct asset; the same machine in the hands of incompetent personnel may be a liability.

The cost of a computing machine itself is a small part of the total cost of making calculations. A machine of the type described in this paper might easily be able to solve as many problems as 50 to 200 or 300 people could program. Even on a highly repetitive job such as heat balances, a good computer, working full time, could make more calculations than a score of engineers could digest. On nonrepetitive work, the ratio of manhours to machine hours would run much higher.

This brings up the question of the organizational setup for using a computing machine. Two possibilities present themselves:

1 A decentralized setup in which the computer is available to each engineer for solving problems which he himself (with or without the help of assistants) has programmed.

2 A centralized computing group to which engineers bring their problems for solution.

Some persons favor the centralized form of operation, others the decentralized plan. Probably a combination of the two is the best. The author's feeling is that an engineer being pushed for the solution to a problem will take more interest in solving it than will a "professional" calculation group. Therefore, each engineer should be encouraged to program his own problems to the limit of his ability and to supervise the running of

TABLE 2 POSSIBLE USES FOR DIGITAL COMPUTERS AND RECORD-KEEPING MACHINES

1	Small, medium, and large repetitive engineering calculations.
2	Special engineering and scientific calculations.
3	The preparation of handbook data.
4	Data reduction (correcting test data to standard conditions and the interpretation of results).
5	Automatic reading, recording, and reduction of test data. (Systems are now being developed for feeding test values directly into computers, without human observers.)
6	System analyses (for example, determination of optimum compressor pressure ratio for jet engine).
7	Weight control in aircraft design.
8	Statistical studies.
9	Traffic control in cities (which streets should be one-way?).
10	Highway planning.
11	Indexing library data for ready reference. (For example, a comprehensive index of all technical information on computers and their associated mathematics.)
12	Computation and preparation for mailing of telephone and electric bills.
13	Magazine-subscription fulfillment.
14	Home-office records of insurance-policy data.
15	Meteorological predictions.
16	Inventory control (nuts and bolts requirements).
17	Production control (what to manufacture, and when, to meet a frequently changing production schedule).
18	Piecework pricesetting.
19	Manufacturing cost estimates (for special products built largely from standard components, such as many industrial products).
20	Economic studies.
21	Management reports (reports the first day of each month for preceding month).
22	Payroll compilation and check-writing.
23	Veterans Administration records.
24	Social-security records.
25	Bank records and clearance of checks.
26	Centralized control of transportation reservations.
27	Truth analyses. (Are there any inconsistencies in an involved legal document? Someday, a computer may win a law suit.)
28	Manufacturing operations-scheduling (consolidation of different lots in a job-shop type of manufacturing operation to minimize set-up costs and increase output).
29	Medical research and statistical studies.
30	Personnel records.
31	Automatic control of machine-tool operations.
32	Business forecasts and preparation of budgets. (One or more computers predicted the outcome of the recent national election at an early hour, but some persons were skeptical of the predictions.)
33	Scheduling the manpower and output for an operation. (A drawing office for example.)
34	Planning military operations.
35	Planning industrial production during national emergencies. (Remember CMP of World War II. This is a natural for a CoMPuter, both for a large manufacturer and for the Government.)

his problems on the computer. Many times, however, the mathematics of a problem will be beyond the know-how of an otherwise good engineer. In such cases, a group of numerical analysis specialists should be available to assist in programming the problem or, if it is unusually complicated, to take over the entire job of programming and running the problem. The central group also should lead in the development of new calculation techniques such, for example, as the development of programs for evaluating the properties of steam, solving differential equations of the types needed in the particular computing-machine application, and so forth.

POSSIBLE APPLICATIONS FOR LARGE-SCALE COMPUTERS

Under this heading may be included just about all big jobs requiring the manipulation of numbers and some problems which a layman would think are not mathematical, such, for example, as the examination of an involved legal document for inconsistencies in the various provisions.

In the author's company, the 701 computer will be used to solve a large variety of engineering problems. These will include the heat-balance problem described in this paper, various kinds of stress and vibration problems, theoretical nozzle and bucket design studies for turbines and compressors, power-plant cycle studies, and many others. In fact, every long or involved calculation procedure, as well as many short but repetitive ones, will be considered as potential problems for automatic computation. The realization of the full potential of a large-scale computer on these problems will take many months or years of developmental effort.

Table 2 lists some of the possible general applications for digital computers and their companion product, record-keeping machines. Record-keeping machines may be used for recording insurance-policy statistics, keeping magazine-subscription lists up to date, recording social-security data, and so forth. They are distinguished from calculating machines in that they are designed for large amounts of input, output, and storage with relatively little calculating while calculating machines are designed for smaller amounts of input and output but larger amounts of computing.

Is the reader's own particular interest listed in Table 2? If not, should it be? To answer this last question is the purpose of the last section of this paper.

SUGGESTIONS FOR MAKING A STUDY TO DETERMINE WHETHER A DIGITAL COMPUTER WOULD BE ECONOMICAL FOR THE READER'S ORGANIZATION

Digital computers are available in a large range of sizes to suit various problems and pocketbooks. For $10,000 to $25,000 yearly rental, punched-card machines may be leased which will solve a wide variety of simple problems and many rather complex ones. Electronic computers with magnetic-drum storage (or its equivalent) may be purchased for approximately $40,000 to $50,000 and up. At the present time, several makes of computers are available with approximately one tenth the speed and one tenth the internal storage capacity of the 1954 or 1955 model imagined by the author. These present-day machines lease for about $200,000 per year or may be purchased for half a million to a million dollars.

The author knows of no better way to determine whether a computer would be economical in a particular case than to ask a long series of questions which should be answered:

1 Consider the calculation (or record-keeping) problem itself.

Is it large or small? If it is small and present methods are giving satisfactory results, automatic calculation probably will not be profitable.

How might machine calculation pay for itself? By solving a wider variety of problems than are now being solved? By making a larger volume of calculations? By completing calculations at an earlier date? By decreasing computation costs? By giving more decimal digits of accuracy? By decreasing numerical errors and procedural errors?

How will the foregoing be converted into profit dollars in the profit and loss statement? By improving the product and reducing complaint expenses? By decreasing the cost of the product? By better customer service and increased sales? By speeding up developmental work through using calculated values instead of engineering estimates in design work? By applying design theories which are not practical without automatic computation?

2 Consider how the problem can be organized for automatic computation.

What will the input quantities be? At what point will the computer start the problem? Where will it end?

Is the problem now organized for automatic computation? If not, who will organize it? How much judgment enters the present procedures? How can this judgment be formulated for an automatic calculator? How often do existing empirical functions have to be extrapolated?

3 Consider the mathematical tools for solving the problem.

Do known methods of numerical solution exist within the reader's organization? If not, what is the likelihood that they exist elsewhere? Is it likely that new methods can be developed at reasonable cost? What is the source of personnel to do this work?

4 Consider the personnel required to carry out items (2) and (3).

Will the calculations use repetitive or nonrepetitive procedures? How much and what kind of personnel will be required? Is the required personnel already in the organization or will it be necessary to hire outside talent? If new talent is needed, is it available at reasonable salaries? What will be the total cost of personnel? Is floor space available for the machine and the needed personnel?

5 Consider the kind of computer required to do the job.

Will a small, medium, or large computer be required? Talk with different computer manufacturers' sales engineers. Which make of computer has design and operating characteristics best suited to the particular job? What is the expected reliability of the machine that appears best suited for the job? Does outright purchase or rental seem most attractive? Who will maintain the machine? What will maintenance cost?

6 Make an economic appraisal of the entire proposal.

List the results which automatic calculation will be likely to accomplish. Review the means by which competent personnel will be obtained. Review the probable cost of the computing machine together with its associated personnel.

Set down the accomplishments and shortcomings of present methods. Tabulate the costs of present methods.

7 Make a decision based on a combined consideration of items (1) through (6).

CONCLUSIONS

A tremendous amount of effort is going into the automatic-calculator field and many of the latest developments have the financial backing of old and well-established companies. It now appears that computers can, in fact, "compute" and that a large number of new applications will appear in the near future. Alert members of engineering management will watch these developments very closely and many will soon decide, just as others already have decided, that the present is none too soon to prepare to use these very powerful new tools because "computers can extend engineering skills."

ADAM COULDN'T FLY

By GEORGE H. PRUDDEN

DIRECTOR, QUALITY CONTROL, LOCKHEED AIRCRAFT CORPORATION, BURBANK, CALIF.

AN ERA OF DRAMA

THIS year we are celebrating the Fiftieth Anniversary of power-driven flight. As such it seems fitting and proper that we should review some of the experiences of that period to glean a lesson or two that might profit us as we look forward to the next fifty years.

I have had the privilege of living through that dramatic era and also the privilege of having been closely associated with the development of the airplane almost from its inception. I have seen it stagger from a fantastic dream to an unbelievable reality. I have seen it pass through the design styling cycles of the biplane, the high-wing monoplane, the low-wing—and now the swept-wing and the delta. I have seen its construction pass through the stages of wood and cloth, all-wood, steel tube and wire, to the all-metal. I have seen the tooling phase through those of the carpenter, to the tinsmith, to fantastic giants of machine design that nobody dreamed of fifty years ago. I have seen a demand and utility come about that nobody in his right mind would conceive of forecasting, even twenty-five years ago.

And through it all I have seen costs rise to heights where I wonder when our economy will reach the point at which it no longer can support them. It is this aspect that I would like to consider briefly.

I chose the title for this paper, "Adam Couldn't Fly," because every day I see a host of people all around me who have never known life without the airplane. They naturally accept things as they exist without question. Everyone is making a desperate effort to improve what we have, but for the most part the trend is toward more critical design, more critical materials, more critical tooling, more critical handling and manufacturing methods. That all costs money, more money, and more money.

From an age standpoint sixty-five per cent of my readers had no association with aircraft prior to 1930. If we were to apply the factor of production demand, that date is probably more accurately 1941. By 1930, the metal airplane, as a type, was just beginning to be established. World War II brought it into universal demand, and the accessory people came firmly into the field.

I am addressing my remarks, not only to airframe people, but to those who build power plants, accessories, and the little black boxes that form the nerve systems of modern aircraft.

For the past ten or twelve years we have been in a sellers' market, except for a short period after the war. Our business is flourishing and we are selling them at millions of dollars a copy. I would like to propose two questions:

What would we do if the world political situation should suddenly soften up?

What would happen to our economy if again we had to build 50,000 airplanes a year—this time at a million dollars a copy?

Either way we'd go broke—or either way we'd find some more economical way to do the job.

Address presented at the Semi-Annual Meeting Luncheon of the Aviation and Turbine Power Division, Los Angeles, Calif., June 28–July 2, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

EARLY DAYS OF THE AIR INDUSTRY

Let us look at the various epochs and trace briefly the growth of this industry.

Prior to World War I there were only a relatively few individuals in various parts of the world with enough daring of life and capital to venture with the air. They spent their own money and took their own chances. You can rest assured that great care was exercised in the expenditure of both. As we look at the photographic record now, the planes of that period appear as haywire contraptions. But I can assure you that they were just as noteworthy engineering achievements then as are the giants of commerce and combat today. Little or nothing was known of aerodynamics, structures, materials, or methods. No books were published on the subject in any language. There was no method of making a quantitative analysis of flight experience.

The English publication, "Flight," was started in 1910, and very important communication of ideas and experiences began. Gradually, we were able to make evaluations from comparative experience.

Then came World War I, and with it, toward the very end, came aerial observation, combat, and a crude form of bombing, by dropping explosives over the side of the cockpit. However, by this means some utility was found for the airplane. But, generally, it left no lasting impression on either the military or civilian mind. It wasn't until some years after the war that General Billy Mitchell had the temerity to suggest that airplanes could fly a hundred miles offshore, bomb and destroy a boat, and return safely to base. The year was 1921—not so long ago. Most everyone knows what happened—he was court-martialed in 1925. Billy Mitchell was a fine soldier, but his thinking was too advanced. This was twenty-two years after the first powered flight.

In the meantime, a small start had been made in scientific study. The Massachusetts Institute of Technology had a small wind tunnel, the Navy had one in Washington, and the National Advisory Committee for Aeronautics had a tunnel and a couple of hangars at Old Point Comfort. They were used mostly for research, but a few of us were running small airplane models for performance evaluations. A standard group of geometrical forms also was being run through these tunnels as well as at the Göttingen tunnel in Germany, Paris, and England, to correlate results and expand universal application of research information.

After World War I, the world turned back to civilian activity even more completely than after World War II. So far as the airplane was concerned, it had played another spectacular, but not too convincingly practical a role.

In 1920 William B. Stout, the far-visioned, intrepid salesman, obtained a contract from the Navy for a bimotor, midwing, torpedo plane—to be built entirely of metal. Today that would be just another airplane. But prior to then, no such airplane had ever been built, or anything remotely resembling it. Dr. Junkers had built a cantilever metal airplane during the war, but little more than news photos had ever reached this country, and little or no effort was made to obtain any such information.

Bill needed help. So I left my teaching job at the University

of Minnesota and went down to Detroit to help him. I don't know whether we faced that job with courage or childish ignorance. Certainly we knew nothing about aluminum alloy nor did the Aluminum Company of America, because they had just started to make it. We knew nothing about the structural problems of an internally trussed wing. Nobody had ever built one, except Dr. Junkers, and there wasn't a scrap of paper in any language that contained the necessary mathematical gymnastics to analyze it. It was a big ship for those days—900 square feet—and had to carry a torpedo weighing a ton. But we built it and it flew successfully. However, the cost of the first unit, $200,000, was more than the Navy could stand—or was willing to. So, that was that!

REDUCING PRESENT-DAY COSTS

Now, thirty-odd years later we are still building airplanes of aluminum alloy and chrome-moly steel. We still use the same basic materials. But we are stretching them. In aluminum alloy first we had 17S, then 24, then 75, and now 78. Each step in advance has made the material harder to work, less resistant to corrosion, and more susceptible to stress corrosion. When we first used chrome-moly steel, we were satisfied and happy to get 200,000 psi. Now we want 280,000 psi. We used to trust almost any good shop to handle it. Now we must be extremely selective, but we can't even trust the extremely selective without setting up controls upon controls and wrapping the parts in cotton batting over night. I'll wager that just the handling, storing, and necessary process control of these materials is costing almost as much as the entire processing did not many years ago. Here is something for some metallurgical genius to think about. We are almost at the point where necessity of itself will drive us to it. It is time that somebody invented a new basic material for aircraft, with a better strength-weight ratio.

Another way of putting it is to reduce the weight of equipment with which the modern airplane is loaded. We are stretching metals to the limit of economy and safety to reduce the weight of the carrier. Let's take out some of the stuff carried or find a lighter method of doing the job.

In the "twenties," we didn't have much need for these things. The only wiring in the ship went from the magnetos to the master switch. Now we have twenty-five miles of wiring in a single airplane. We didn't have any radio because there wasn't anybody to talk to anyway. Our landing gears didn't retract, nor did we use flaps or booster systems—so we had no hydraulic systems.

Much has been done to reduce this weight. The Liberty engine of World War II developed 400 hp and the installation with radiator and water weighed 1350 lb or, roughly, 3.4 lb per hp. As I recall, the engine cost approximately $9000, or $22.50 per hp. Engines today weigh less than 1 lb per hp and cost $20 per hp—a remarkably good record.

Hydraulic systems in many instances have given way to pneumatic systems at a great reduction in weight of tubing and contents. We have made money on that one, too.

In the realm of electronics, much remains to be done. Unfortunately, too many of us who are in a position to control costs, and so on, are unacquainted with this comparatively new science. However, we can all observe that these mysterious boxes are big, black, and heavy; that they cost a lot of money; that they have to be installed by well-trained technicians, who, because of their peculiar knowledge, live in a world apart. All we can do is watch them remove and replace and fool with the intricate traceries of wiring. We can also observe costly repetition of flights to prove the results of their work. We don't have to be electronic experts to draw the conclusion that its cost is way out of proportion to anything else that makes up the modern airplane.

It is extremely unfortunate that missile contracts are so highly classified. It doesn't require a mind trained in electronics to observe that in that field the old law of necessity has developed small light telemetering and control devices that are tremendously more reliable and rugged than much of the electronic equipment in our airplanes. It is also easy to observe that there is no flight pay involved and somehow or other the equipment works the first time. That alone pays off even if piece for piece the cost is comparable.

HOW IT WAS DONE IN 1922

I have tried to avoid injecting myself into these observations. But we had an experience back in the early twenties that was so illustrative of what sheer necessity will do for one that I will hazard the reference at this point.

When we finished the contract on that first all-metal airplane for the Navy in 1922, we were through—all washed up. As I have said, the first unit cost $200,000.

The Navy wanted no more. The Army had warehouses full of surplus. There was no commercial aviation anywhere in the world. The air mail had just barely started and there was some question as to its value and continuance. There was virtually no demand for the airplane. If there was to be a future for the business, we had to make it. It was quite obvious that cost was a paramount factor in that future. We had to make the airplane less expensive or quit altogether.

Now it didn't take any harder thinking to make a new approach. All we had to do was analyze what had contributed to the cost and eliminate those factors.

One important thing had taken place during those two years that made a new approach possible. The Aluminum Company of American decided to let us in on their closely guarded secret of heat-treating.

The Bauch Machine Tool Company also came into the picture and presented just enough competition to the Aluminum Company of America that we began to get some improvement in material. But the principal boost that we got was release of the secret of heat-treating. We were no longer hamstrung by material gage. We could simplify our structure, use fewer parts, expand tolerances, and make the parts more closely related to a man's hand. We could corrugate the skin and eliminate ribs. I look back on that day as a paradise of emancipation. It didn't happen as easily as it sounds. But it had to happen or we were through. It was forced by necessity.

There was another large factor of cost that had to be surmounted. We had no mechanical aid for riveting. Upsetting every rivet with rivet set and peen hammer was a long and difficult process. We tried various devices of cam and springs attached to electric motors with no success. The offices of the Chicago Pneumatic Tool Company were only a few blocks away. It took more than a little urging to get them to design and build a small tool for the job because there was no outlook for volume sales. We didn't even think so ourselves. But they finally produced a small pneumatic hammer and we were on our way.

With the ability to form metal in the soft state and heat-treat it ourselves, and with the pneumatic rivet hammer, we were able to produce an all-metal airplane with an entirely new basic concept.

It became the original Ford Air Transport and the first article cost only $25,000—just one eighth of the cost of the Navy job which was almost comparable in size.

But Henry Ford wasn't in the picture yet, nor was the famous trimotor. That in itself is an interesting side light on the status of the airplane. We wanted to build a trimotor and there was

only one suitable engine being built—the Lawrance radial. I went down to see Charlie Lawrance on 40th Street and the East River in New York City. He told me that he was making all the engines he could for the Navy and he didn't believe that commercial aviation would ever amount to anything anyway. To be perfectly honest, we weren't too sure that it would, either. It all still had to happen. That was the year 1924.

A year later the old Wright Aeronautical Corporation was dug up and reformed with Charlie Lawrance's engine as a nucleus. They brought a sample of his engine in and put it in my office. The Ford trimotor was the result.

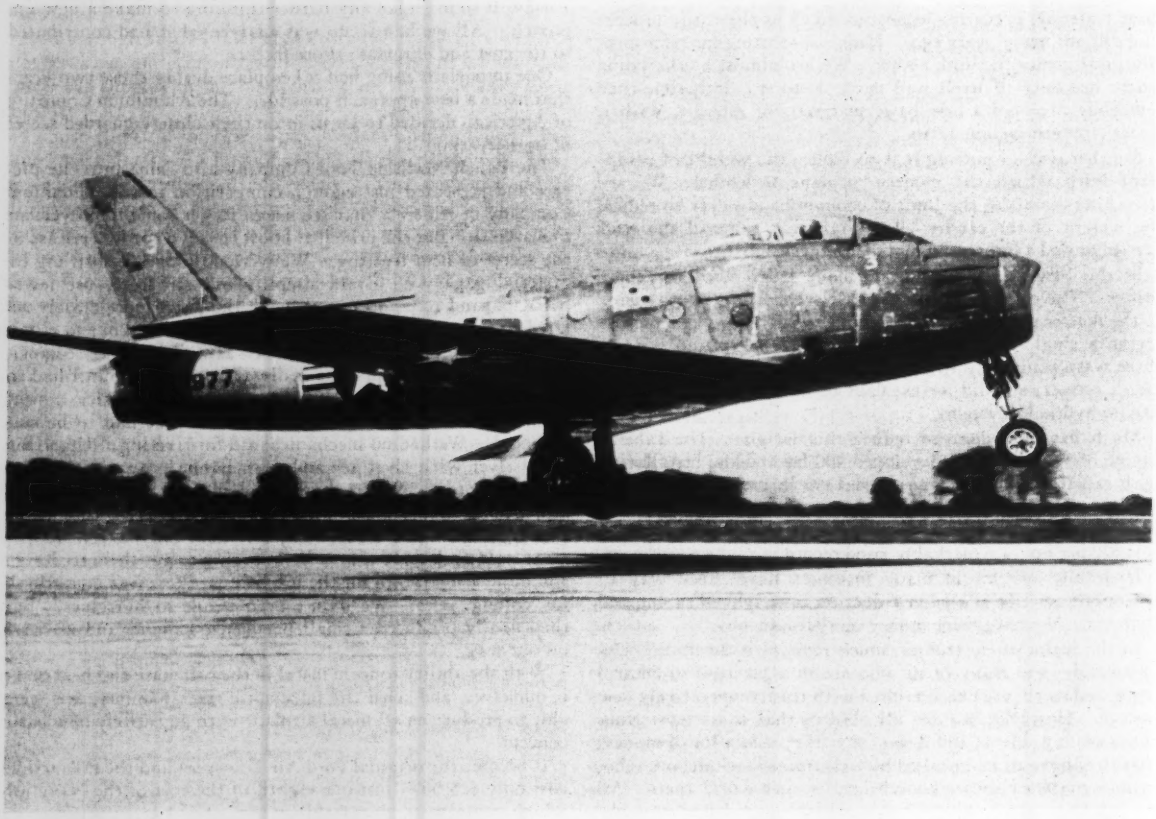
BEGINNING OF THE MASS-PRODUCTION ERA

It wasn't that this airplane was such a success that was in itself important. What attracted Henry Ford was that we could build such an airplane for so little money, and the fact that mass production could be achieved from metal construction intrigued him. When he bought the company in 1925, the name Ford gave the airplane an industrial standing and removed the stigma of crackpot invention. That and Lindbergh's flight to Paris a few years later aroused world interest in the airplane as a transportation medium. Money became available and we could look forward farther than from week to week for a pay check.

We now had the pneumatic rivet hammer and we could form metal in the soft state. But we could form it in only one direction. We had only the forming rolls and the tinner's brake. Even though presses may have been in existence, we didn't have the kind of money that would buy dies for them. In 1928 I had a fellow make a toilet seat for a plane we were building. This was one of the first "3-D" attempts at forming aluminum alloy. The result was terrible. Something had to be done to make that plane purely all metal. We took a toilet seat and put it on the floor with an open-top box around it. Into this we poured cement. When the block had hardened we turned it over and poured another on top of it. We had two cheap dies. We erected some wooden ways and with the aid of a block and tackle with trip release made ten perfect toilet seats in fifteen minutes. That was the start of the drop hammer, without which tool we could never have made the transition to the high-production airplane that we know today.

A NEW APPROACH NEEDED

The drop hammer has pretty much seen its day and the airplane has entered almost entirely the machine-tool stage. I sometimes wonder if we haven't overdone it—or rather, are the machine-tool people alerted to another possible day when we may be called upon to build 50,000 airplanes a year. I hope we haven't forgotten the difficult tooling period we had in World War II. Where and how fast will we be able to obtain these giant tools in a future emergency? At least one farsighted person, "Pappy" Van Dusen, has a reinforced-concrete design. I am sure we will need more of that kind of thinking to cut costs and make the airplane more readily available.



THE FIRST NEW AIR FORCE F-86H SABRE JET OFF THE PRODUCTION LINE AT NORTH AMERICAN AVIATION'S COLUMBUS, OHIO PLANT, COMPLETES ITS FIRST SUCCESSFUL FLIGHT

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Fundamental Research

IN the next few years the General Electric Company plans to increase its scientific staff working on fundamental research by 50 per cent from a present force of 1000 to 1500, according to President Ralph J. Cordiner. Included in the expansion will be the addition of 180 scientists to a present 270. Physical facilities for research and advanced engineering-development work already have undergone expansion since the war amounting to approximately $120 million.

He said that while industry already has a store of technology which offers tremendous opportunity for growth in the immediate future, the nation cannot afford to neglect basic research which discovers the new facts on which future technology will be based.

The problem, he said, becomes one of looking ahead far enough to make sure that plans for the future place proper emphasis on both fundamental research and applied research and advanced development.

Solution of only a few problems, in the belief of Mr. Cordiner, would make major contributions to the world's way of living. The problems, for which scientists are seeking solutions, include the following:

1 Development of new high-temperature alloys which would permit higher operating temperatures for heat engines such as turbines with a resulting increased efficiency.

2 Development of permanent magnets ten times stronger than present which would permit reduction in size of motors and transformers and open up the possibility of adapting permanent magnets to assembly-line operations.

3 Improved heat-storage systems which would solve the off-peak electrical load problems and also would increase opportunities for storing solar energy. This would permit using electricity at night when demand is low to produce heat which could be stored for daytime use and also would permit storing solar heat in the daytime for use at night by means of heating water or chemicals.

4 Development of infrared-sensitive phosphorescent materials capable of converting infrared into visible radiation which would make possible much more efficient light sources.

5 Development of a system for the direct conversion of the energy of gaseous combustion into electrical energy by means of a "fuel cell" which would greatly increase the efficiency of conversion.

6 Development of superconducting materials, now known at only low temperatures, for use at average normal temperatures to give high performance at practically zero loss of electrical energy. There is a large amount of electrical energy loss because of resistance in wire and other conductors. At near absolute zero temperatures the conductivity is many times greater because resistance is almost negligible.

7 Development of a magnetic oxide method which would permit molding or casting of the cores of motors and transformers, thereby eliminating the present laborious method of stacking sheets of material to form the cores.

Mr. Cordiner pointed out that General Electric, because of its belief in the job ahead, has engaged in a post World War II program for expansion and modernization that will reach $1,100,000,000 by 1955. In this expansion the company already has spent $120 million for improved facilities for research and advanced engineering-development work.

Supersonic Flight

ACCORDING to research scientists now wrestling with the business of building "beyond-the-barrier" planes that must withstand the tremendous heat of jet engines and hold together at supersonic speeds, penetrating the sound barrier has resulted in a whole new series of headaches for the aircraft industry. An article by Edward J. Doherty, Jr., in *Steelways*, August, 1953, explains some of the problems and achievements of the aircraft industry and describes the increasingly important role that steel is playing in aircraft today.

To cope with the radical change in the shape, design, and performance of jet-age aircraft, the industry has recruited more technicians than ever before in the 50-year history of powered flight. (Aircraft Industries Association statistics show the

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

industry now employing almost one of every four research scientists and engineers engaged in all U. S. industry.)

The article explains how the element of rush—brought by the day-to-day, hour-to-hour changes in aeronautical developments—serves as a tailwind in our race to surpass the air strength of the Soviet Union. It is our ability to produce these new developments faster that has brought us the qualitative lead in the battle for control of the air.

The job confronting the aircraft industry is to turn out planes that can take off from a standing start; fly through the compressibility barrier; operate efficiently above 40,000 ft; withstand tremendous temperature changes; and still permit a pilot to resist the blast-furnace heat of the engine.

In the matter of engine heat, specially developed alloy steels are rapidly replacing less heat-resistant metals. An earlier engine, for instance, used 109 specifications of materials of which 70 were steel, whereas a newer engine for planes just getting into production calls for 133 materials of which 100 are steel.

Because of steel's great fatigue strength and resistance to high temperatures, it is also finding wider application in the manufacture of airframes. Mr. Doherty points out that aluminum, the material in common use for fuselages, gets so hot at sea-level speeds of 1000 mph that it cannot be used for our fastest planes. One fighter manufacturer uses 15 to 20 types of steel in the airframe alone.

Turning out a wing strong enough and with enough flexibility to meet the varying conditions encountered in high-altitude flying is another aerodynamic problem. Wings have gone from the conventional straight type of the early jet to the sweptback wing which was an important factor in outracing sound. But even this latter wing had its handicaps and a newer version of it—permitting the pilot to adjust it in flight to the most efficient degree of sweep for any given condition—is currently being tested.

There are other problems besides heat and air compressibility. Cost of component parts and labor, for instance, has skyrocketed. Where it took 8666 man-hours and $52,000 to build a World War II propeller-driven fighter, a modern jet fighter today takes 30,133 man-hours and $240,000.

The 50th anniversary of powered flight, the article notes, finds the aircraft industry in second place among the leaders of American manufacturing industry and anything but discouraged. One engineering executive even predicts that military aircraft will be flying at an altitude of 65,000 ft and at twice the speed of sound (1522 mph at sea level) within the next six to eight years.

Mass Flowmeter

THE operation of a flowmeter which accurately measures the mass flow of fluid was described by V. A. Orlando and F. B. Jennings, General Electric Company, West Lynn, Mass., at an Instruments and Regulators Division technical session during the 1953 Semi-Annual Meeting, Los Angeles, Calif. In the paper, entitled "The Momentum Principle Measures Mass Rate of Flow," the authors said that compared with conventional flowmeters, this instrument has many advantages, including a linear torque output easily adaptable to direct reading, remote indication, or control initiation. They reported that it is installed more easily in pipe lines than most flowmeters and can be mounted in any attitude. It has high accuracy, low pressure loss, small size, and lightweight. The sample was tested using liquid petroleum fuels of various viscosities and densities, giving errors less than 0.5 per cent of full scale.

For many years, they pointed out, experimenters have explored means of measuring the rate of fluid flow on a true mass basis. Mass flow measurements are required in such applications as the combination of reagents in chemical processes; the transportation of different fluids in pipe lines; and the measurement of fuel consumption in aircraft. Conventional flowmeters used to measure mass flow rate are compensated for errors due to density and viscosity changes of the fluids.

PRINCIPLE OF OPERATION

The principle of operation of the flowmeter is as follows: The unit consists of two similar cylinders placed end to end so that the two axes coincide. The instrument housing closely fits the outer diameter of the cylinders. Around the periphery of the cylinders are located a number of passages, the axes of which are parallel to the axes of the cylinders. Fluid moving through the pipe line enters the passages in the first cylinder, proceeds through the passages in the second cylinder, and continues along the pipe line. By driving the upstream cylinder, termed the impeller, at a constant angular velocity about its axis, the fluid is given a constant velocity at right angles to the fluid flow. This angular velocity constitutes a change in momentum of the fluid. The second cylinder, termed the turbine, is designed to remove all the angular momentum from the fluid. In doing so, a torque is exerted on it in accordance with Newton's second law of motion. This torque deflects a spring restraining the turbine. The angular deflection of the turbine is a measure of the mass rate of flow.

DESIGN POSSIBILITIES

An important feature of the flowmetering principle, the authors stated, is the possibility of applying it to designs satisfying various specific flowmetering applications. A few of these designs, that show promise of useful applications, are the following:

For control initiation, remote indication and recording, or totalizing, it is often useful to have the output in the form of an electrical voltage which is proportional to the flow rate. A suitable signal can be obtained with low friction from a variable-ratio transformer whose armature is supported on the turbine shaft. Such signals from two or more flowmeter outputs can be added by connecting them in series and the totalized flow rate can be presented as a separate indication.

The total mass of fluid which is passed through the flowmeter can be measured by integrating the flow rate with respect to time. One of the simpler means of accomplishing this is to use a servo motor to drive both a tachometer and a counter which indicates the total mass of fluid. The error signal which is amplified to operate the servo motor would be the difference between the tachometer output and the signal from the flowmeter.

The authors conclude that the tests have shown that this principle of flow measurement can be applied with highly satisfactory results to the measurements of the mass rate of flow of

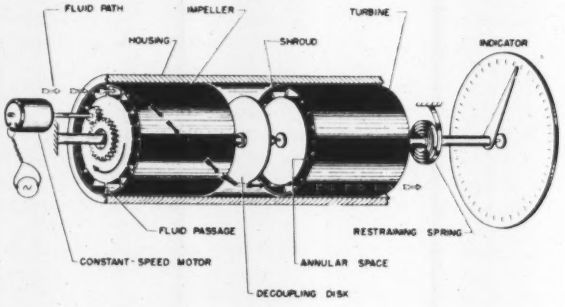


FIG. 1 DIAGRAM SHOWING PRINCIPLE OF MASS FLOWMETER

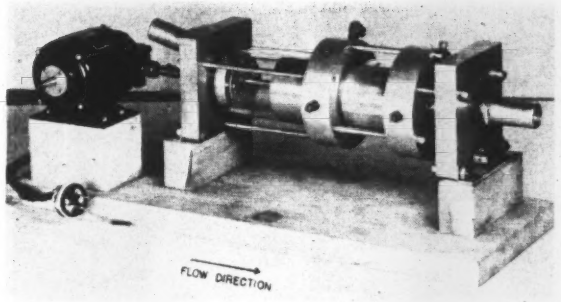


FIG. 2 SAMPLE FLOWMETER

liquids. The operation of the sample demonstrated many features which previously have not been combined in one flow-measuring unit. Now it can be expected that mass flow of liquids and gases will be indicated or recorded in whatever way is most convenient for the application. This type of instrument, they said, holds promise of finding many applications in the chemical, aircraft, and other industries.

Electric-Furnace Study

ACCORDING to a two-year research project just completed by 14 electric utility companies and Bituminous Coal Research, Inc., Pittsburgh, Pa., the coal, steel, and electric utility industries could make or save many millions of dollars.

Approximately 83 million tons or 89 per cent of total United States steel is made in open hearths. Most of this is low-carbon steel. The electric utility industry and the coal industry, knowing that both would benefit materially if electric furnaces replaced open hearths, joined forces to conduct a comprehensive technical-economic study to discover whether the electric furnace could compete with the open hearth for this major part of the nation's steel production.

Both industries stood to gain stabilization of production at a higher level, as well as increased sale of their product.

Three plant sizes were studied—250,000 tons, 500,000 tons, and 1,000,000 tons of annual steel production.

They discovered that replacing open-hearth furnaces by electric furnaces could (1) decrease the cost of making low-carbon steel from cold metal up to $3.15 per ton, (2) increase the national output of electricity by 12 per cent, and (3) increase coal production about 25 million tons a year. The latter two estimates assume a total replacement of the existing 950 open-hearth furnaces by 760 electric furnaces.

Open hearths are fired primarily with oil; electric furnaces operate on power usually generated from coal. Future changes in costs of fuels and metals used by the electric furnace and the open hearth are expected to favor the electric furnace.

Manufacturers who supply or service the coal, electric, and steel industries also stand to increase sales by many millions of dollars. For example, the 25 million tons of coal needed annually for generating the additional electricity would mean $25 million worth of mining equipment. This tonnage means millions of dollars in freight revenue to the railroads and other transportation companies. Supplying power for the electric furnaces for the maximum potential steel tonnage would mean installation of 19 million kw of additional capacity. To build and equip these power-generation facilities would take an investment of $3 billion, not including transmission. The electric-furnace installations would mean over a billion dollars in sales to manufacturers of furnaces and auxiliary equipment.

Even a 10 per cent switch to electric furnaces in the near future holds tremendous importance to the industries concerned, the study notes. Almost 7 million tons of alloy and low-carbon steels were made in electric furnaces last year.

ELECTRIC FURNACES VERSUS OPEN HEARTHS

Up to the present, electric furnaces have been used primarily for the production of special alloy steels. During World War II, electric-furnace steelmaking expanded to supply increased demands for high-quality steels. At the end of the war, demands for these steels declined and excess electric-furnace capacity led some manufacturers to experiment in using this equipment to manufacture low-carbon steel. About the same time, important developments and improvements in equipment, such as the swing roof, high rates of energy input, and increase in furnace size, took place. These improvements reduced charging time, decreased melting time, and lowered current consumption. As a result, important economies were achieved which brought electric-furnace steelmaking costs to the level of the open-hearth process.

The comprehensive evaluation just completed proved what had been indicated by the isolated experiments of individual steel companies who used the electric furnace to make low-carbon steel.

The research was conducted by Battelle Memorial Institute for the electric utility companies and Bituminous Coal Research, Inc., and the findings have been published in an 80-page report. This report shows that capital cost for electric-furnace installations is only 60 per cent of the cost of open hearths; that the cold-melt steelmaking process using scrap and pig iron shows lower cost for the electric furnace; and that electric furnaces show a greater annual return on invested capital.

FIG. 3 TAPPING A 100-TON LECTROMELT FURNACE
(This type furnace is suitable for the production of low-carbon and alloy steels.)

For the 50 per cent hot metal–50 per cent scrap metal process, annual return on invested capital with the electric furnace is equal to or greater than the open hearth. The study and report were based on full-capacity operation. Less than full-capacity operation would tend to favor the electric furnace because fixed costs are lower.

Only the most modern open-hearth installations were used for the study. No plant more than eight years old was included. Costs shown for open-hearth operation are the lowest which have been achieved or which the steel industry considers to be possible. For the electric furnace, costs have been used which are conservative and beyond challenge. Three representatives of the steel industry advised on the collection of data and preparation of the final report.

OTHER ELECTRIC-FURNACE ADVANTAGES

According to the report, in addition to reduced capital investment and reduced cost of steel production in cold-melt practice, the electric furnace offers steel company management the following other important advantages over the open hearth:

1 The electric furnace is more flexible. It can be put into production or withdrawn at will while the open hearth must be fired even when idle in order to protect the brickwork.

2 Electric furnaces can be kept in operation all but about 15 days a year while open hearths are usually down about 30 days. Rebuilding time is shorter for the electric furnace.

3 The yield of the electric furnace is about 2 per cent greater than the open hearth for the same amount of materials.

4 The electric furnace gives greater control of sulphur in the production of deep-drawing sheets and welding grades of steel.

5 Because of its better temperature control the electric furnace saves time in steel production. Nitrogen control by the electric furnace is expected to match that of the open hearth.

The report contains detailed tables showing not only costs, but also operating data—pounds, gallons, man-hours, etc.—so steel companies can readily apply their own operating and cost data to evaluate electric furnaces versus open hearths for their own plants. It can be obtained at $10 per copy from Bituminous Coal Research, Inc., 2609 First National Bank Building, Pittsburgh 22, Pa.

The Electric Furnace Survey Group which sponsored this research project includes: Bituminous Coal Research, Inc., Pittsburgh, Pa; Alabama Power Company, Birmingham, Ala.; Cincinnati Gas & Electric Company, Cincinnati, Ohio; Cleveland Electric Illuminating Company, Cleveland, Ohio; Detroit Edison Company, Detroit, Mich.; Duquesne Light Company, Pittsburgh, Pa.; Ohio Edison Company, Akron, Ohio; Ohio Power Company, Canton, Ohio; Pennsylvania Electric Company, Johnstown, Pa.; Pennsylvania Power & Light Company, Allentown, Pa.; Philadelphia Electric Company, Philadelphia, Pa.; Public Service Electric & Gas Company, Newark, N. J.; Utilities Research Commission representing Commonwealth Edison Company and Public Service Company, Chicago, Ill.; and West Penn Power Company, Pittsburgh, Pa.

Ceramic Coatings

A CONVEYERIZED, mass-production facility for applying high-temperature ceramic coatings to alloy-steel components has been placed in operation by Solar Aircraft Company, San Diego, Calif.

The 4000-sq ft installation is said to cut coating time in half

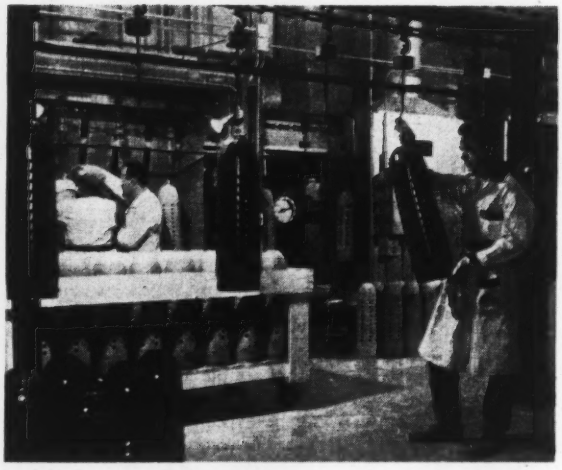


FIG. 4 COMBUSTION CHAMBERS FOR GENERAL ELECTRIC J47 TURBOJET ENGINES ARE SHOWN BEING PROCESSED IN CONVEYERIZED MASS-PRODUCTION FACILITY BUILT FOR APPLYING HIGH-TEMPERATURE CERAMIC COATINGS TO ALLOY-STEEL COMPONENTS

on critical jet-engine parts. At present the facility is being used for Solaramic coating inner combustion chambers and transition liners for General Electric J47 turbojet engines. However, the equipment is adaptable for mass-production coating of other military or civilian items.

The Solaramic process is a family of ceramic coatings that protect metals against high-temperature oxidation and corrosion. The coatings lengthen the service life of metal parts subject to temperatures of 1200 F and higher, or alternatively allow the substitution of parts made of lower alloys, less rich in strategic elements, for uncoated high-alloy parts with equal or longer service life.

Built under Air Force auspices, this conveyerized coating department is able to handle 5000 combustion chambers and 5000 transition liners a month on single-shift operation, with a working force of 12 employees.

Operations in the conveyerized coating department start with receipt of fabricated combustion chambers and transition liners from the manufacturing shop. The first step is automatic sandblasting of the parts to produce a roughened surface assuring good bond strength between coating and metal.

Following sandblasting, the parts are sprayed with a Solaramic coating. Spraying operations are divided into three steps: inside spraying, outside spraying, and touch-up and stenciling. At present, spray operations are manual, but Solar is now studying automatic or semiautomatic spraying equipment. Only one coat of the ceramic liquid (or slip) is required. Identification marks are stenciled on the parts using a Solaramic which fires into a contrasting color.

Parts are hung on the conveyer line following inside spraying, before the outside coat is applied, and remain on the conveyer throughout the processing outlined below. The conveyer line now travels at 2 fpm.

Following the spray operations, the coating is dried, using gas-fired direct-flow dryers operating at 150 F.

After being sprayed, parts enter the furnace where the coating is fired at a temperature of approximately 1700 F. The gas-fired furnace has a 15-ft firing zone.

When the jet-engine parts leave the furnace, they continue on the conveyer line while cooling. Finally the parts are inspected and packed for shipment.

Entire cycle time, from receipt of the parts, to packing of the coated components for shipping, is one hour.

Plastics Today

AUTOMOBILE bodies, Arctic sleds, and car windows made of plastics are becoming a reality on a commercial basis, and many other new applications for plastics for mass-production markets steadily are being developed, according to William T. Cruse, executive vice president, The Society of the Plastics Industry, Inc., New York, N. Y.

One-piece plastic refrigerator door liners have been developed and are already standard equipment in several mass-produced refrigerators. In addition, linings for the complete inside of the refrigerator have been produced experimentally and, it is believed, will soon be offered commercially.

Plastic pipe made of the several different types of raw materials is finding many applications for use in oil fields, water and gas lines, and industrial plants and is being tested on two vessels by the U. S. Navy.

The automotive industry 20 years ago used plastics mainly for such items as instrument-panel escutcheons, panel parts, electrical shades, accelerator foot pedals, knobs, and door trim. Today, plastic sports-car bodies are being made by several reinforced-plastics manufacturers with the automotive industry as a whole seriously studying this type of material for use in the mass production of passenger cars, as well as in the truck and tractor fields.

The aircraft industry which for years has been experimenting with and developing plastics applications because of their strength and lightness, is now producing larger parts than ever before. The pilot's enclosure on many of today's helicopters consists mainly of a plastic sphere, permitting observation in all directions. The lead edge on the wings of jet planes is made of reinforced plastics because they resist the wear caused by friction when flying at speeds faster than sound and in high altitudes, better than other materials.

Yesterday, the formulations of reinforced plastics were highly secret as they were involved with radar-equipped aircraft; today, reinforced plastics, as they appear more and more in boats, building materials, storage tanks, and armour vests, are becoming widely known to the American public.

In the home, wall tile made of colorful polystyrene plastics is meeting an increased acceptance. This plastic wall tile is resistant to soap and water and has particular appeal because it can be installed by the home owner. Melamine-plastic dinnerware also is being accepted more and more by the American housewife as a quality product for her home.

Flooring material made of vinyl plastics in tile and sheet form, appears to have a large future market judging by public acceptance of it over the last three or four years. Vinyl flooring, besides being colorful and not difficult to lay, is resistant to gasoline, kitchen greases, and strong soap. This makes it ideal for the floors of kitchens and playrooms as well as office buildings and public institutions.

The packaging of all types of products from foods to chemicals is being handled on an increasing basis by the different plastics raw materials. Bags made from plastic film are generally accepted for the sale of many food items and for storage purposes in the refrigerator. Plastic bottles are used extensively in the cosmetics and drug fields and now the chemical industry is using them up to 13 gal capacity in the form of carboys to transport liquids which normally affect glass and metal. Products made of these plastics are particularly adaptable where corrosive conditions exist.

Plastics are going into bigger products all of the time. Their lightweight, strength, ability to be produced in one piece, insulating qualities, and variety of colors, are important factors in this normal expansion into new and bigger fields. To cite a few examples, swimming pools now can be lined with a plastic sheeting; bath tubs molded in one piece now are made of plastics the same as Arctic sleds for the military; television cabinets; pipe and tubing in longer lengths and larger diameters and fittings to go with them; outdoor-advertising signs; aircraft structural members; furniture; luggage; diaper hampers; counter and table tops; radomes; etc.

The constant increase in size of products made of plastics is due to a large extent to the manufacturers of plastics machinery and equipment who have kept up-to-date with the rapid growth of the plastics industry by constantly enlarging the productive capacity of their machines to keep pace with the industry.

Approximately 23 lb of plastics were available for each of the 154,000,000 persons in the United States in 1952 and it is predicted that about 28 lb of plastics will be available to each of the anticipated 166,000,000 persons in the U. S. in 1955. Production of all plastics raw materials in 1953, SPI estimates, will be approximately 2,800,000,000 lb.

Reinforced-Plastic Tank

A 3400-GAL reinforced-plastic transport tank for commercial trucking, said to be the first of its kind in the United States, has been constructed to haul formaldehyde and similar liquid chemicals. Made of American Cyanamid Company's Laminac polyester resin and fibrous glass reinforcement, it is one of the largest one-piece molded structures ever made, measuring 21 ft 9 in. long; 6 ft 2 in. wide; and 4 ft 4 in. high, unmounted.

When fully equipped and mounted on the trailer, the new oval-shaped tank weighs only 7025 lb, 3600 lb less than the steel tank it replaces. This weightsaving, it was pointed out, should permit dramatic economies.

In addition, a saving of $1000 is also possible because, unlike a steel tank, no special lining is required—an advantage that could lead to mass-produced plastic tanks costing only one third as much as the stainless-steel type. Another economy stems from the fact that the reinforced plastic is highly resistant to corrosion and requires less maintenance. If leaks develop in a steel tank, they are both difficult and expensive to repair, while a plastic model can be patched easily with resin and glass at a very small cost.

The tank, molded by Carl N. Beetle Plastics Corporation, is fitted to a trailer chassis specially designed and built by Frue-

FIG. 5 REINFORCED-PLASTIC TRANSPORT TANK SHOWN BEING MOUNTED ONTO TRAILER CHASSIS

hauf Trailer Company and is pulled by Mack Motor Truck Corporation's new model tractor, Mack B60T. Special dent-resistant fenders and the hose and pump compartments are made of the same sturdy plastic-glass combination as the tank.

Punishing tests were recently completed on the tank to determine its strength under severe driving conditions. Filled with 27,430 lb of water, it was measured for strain-resistance by strain gages and accelerometers attached to its surface. Then the chassis was twisted until one rear wheel was lifted clear of the ground. For a road test the Laminac-glass tank was raced over a rough dirt stretch outside of Fall River, Mass., and over rough and smooth paved roads. During all these tests, the highest bending stress reached was 840 psi, compared to the breaking point of the material of 20,000 psi.

The tank was manufactured over a wood mold. Laminac resin was sprayed on, and after this layers of glass mat were added and a specially catalyzed resin was spread over each layer.

The transport tank will be operated by Mutrie Motor Transportation, Inc., of Waltham, Mass.

Giant Tube Reducer

A GIANT compression-method tube-reducing machine now under construction for Tube Reducing Corporation, Wallington, N. J., will increase by severalfold the available size of tubes cold-finished by this new process. The giant tube reducer will process ingoing tubes up to 18 in. OD. Largest tube reducer now used takes an ingoing tube of $6\frac{1}{2}$ in. OD.

Sizing tubes by this compression method is said to be a complete departure from the long-used cold-drawing process. The new method cold-works tubing to size and shape under compression instead of tension as in cold drawing. Compressive working of the metal develops mechanical properties in the tubing considerably greater than are normally produced by cold drawing and also makes it possible to produce tubing to closer tolerances.

The compression process is actually a rolling, cold-forming operation which might be broadly described as cold-pilgering. A roll housing, or "saddle," as it is called, is mounted on wheels so that it can move back and forth over a stationary tube during rolling. Two rolls, upper and lower, containing insertable taper-grooved dies, are driven in synchronization with the saddle motion through gears engaged in stationary racks. The rolls oscillate or "rock" over the stationary tube as the saddle reciprocates, hence the copyrighted name of "Rockrite" tubing used by Tube Reducing Corporation for this class of cold-finished tubing.

The giant tube reducer, more than 100 ft long when completed, will be used to produce precision seamless tubing ranging in size from 17 to 9 in. OD and in wall thickness down to 0.125 in. The large-diameter light-wall tubing will be used in the manufacture of components for large aircraft, rockets, jet engines, and military items now under development.

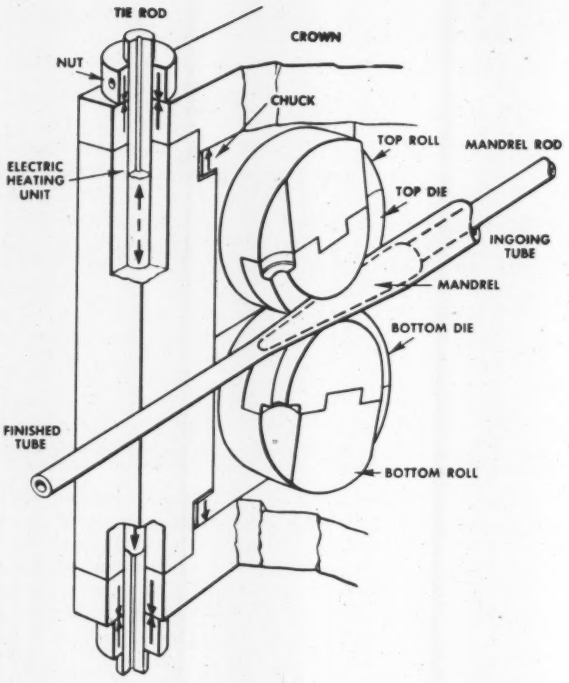


FIG. 7 METHOD OF PRELOADING SADDLE FRAME, ROLLS, AND ROLL NECK BEARINGS

The new tubing also will be used in the manufacture of large-sized ring-shaped parts, cylinders, accumulators, casings, large volume pressure conductors, and other products for thin-walled high-strength applications. Using compression-formed tubing for these products will eliminate the need of the extensive machining required with heavier-wall cold-drawn tubing or forgings.

The giant tube reducer will process any of the metals processed by the standard-sized smaller machines, which include carbon and alloy steels, aluminum, copper and brasses, stainless steel, titanium, and any of the new metals.

As shown in Fig. 6, four principal sections will make up the new tube reducer: the roll housing at one end, tube-feeding equipment in the center, the drive assembly, and the mandrel-handling machinery.

The roll housing alone when completely assembled with roll neck bearings, rolls, and dies will weigh over 150 tons. Size of each roll will be 50 in. in diameter, which is dictated by the size of the large bearings needed to support rolling loads of over 3 million lb. The bearings selected are 48.0315 in. OD, 17.244 in. wide, and have a load rating of 3,200,000 lb, which, it is reported, is the largest capacity ever produced in this type of bear-

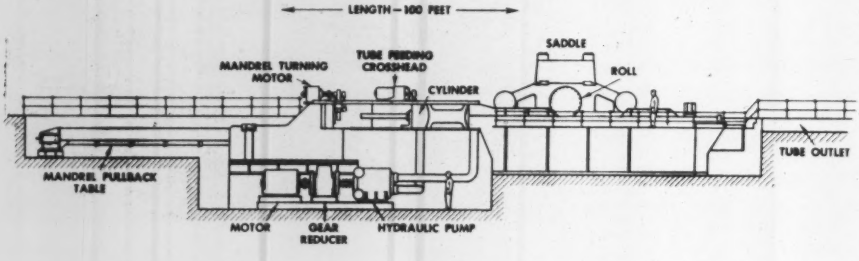


FIG. 6 SKETCH SHOWING PRINCIPAL SECTIONS OF GIANT TUBE REDUCER

ing. The dies, weighing approximately 7500 lb each, will be made of fine-grade through-hardening alloy steel, heat-treated to provide a hardness of Rockwell C-60 to a case depth of about $^3/_4$ in.

The company has incorporated into the design of the giant tube reducer the feature of preloading the saddle frame, rolls, and roll neck bearings to offset the calculated 3,500,000 lb separating force between the two rolls.

Preloading consists of placing a compression preload to maintain the position of the reducing rolls up to the separating force. To preload the frame, the four tie rods, Fig. 7, securing the frame to the housing are constructed with cal-rod units near the top center of the rods. By heating the tie rods and then tightening the securing nuts down on their expanded length, a high compressive load results when the rods shrink back to normal.

Lubrication

RECENTLY, new greases thickened with solid materials rather than with the standard soaps have appeared, according to the July, 1953, issue of the *Industrial Bulletin* of Arthur D. Little, Inc. These greases, the *Bulletin* notes, stand up well enough to carry the industry closer to the ideal of the multipurpose lubricant. They are expensive, but one of the newest solid thickening materials, processed fuller's earth, is expected on the market in the near future and may be cheap and sturdy enough to replace many of the special-purpose products.

Most lubricating problems, except for those caused by actual lack of lubricants, arise because the grease escapes from the bearings. Better bearing design can help to prevent this, but a grease that will not become too fluid when hot, or too stiff when cold is still required.

Today, the article explains, greases are made chiefly of petroleum lube oils converted to a greaselike consistency with a gelling agent, usually a soap, much as water is gelled by gelatin. For some uses, sodium soaps, similar to household soaps, are adequate; calcium, barium, aluminum, and other metallic soaps are needed for other kinds of greases. Some of the newest and increasingly popular greases are prepared with lithium soaps and seem best able to withstand extreme temperatures. Despite much development effort, however, no one of the soap-based greases can withstand all the conditions of heat, cold, water, corrosion, and other extremes encountered in the hundreds of applications required of greases. Specific formulations for each of these problems have been needed. In recent years, of course, other types of lubricants have been developed for special applications. Among these are the silicone greases, molybdenum-disulphide-powder additives, and modified oils for conditions of extreme pressure. Because of either cost or limited areas of application, however, these materials are not suitable for widespread use.

Some of the new solid-type thickeners for petroleum lube oils bear a startling resemblance to ordinary dirt, the last thing one would normally put into a bearing, the *Bulletin* states. They are, however, composed of such fine particles and are so highly refined to rid them of abrasive materials that they do not contribute to bearing wear. Their chief value lies in their remarkable ability to convert petroleum oils to a desirable gel. Bentonite, silica aerogel, and, more recently, other forms of silica as well as special types of colloidal fuller's earth have been found to possess this property. Of these solids, only one, the silica aerogel, is made artificially; the others occur naturally.

When these solids are properly dispersed in lubricating oils, using surface active agents, the resulting greases have a wide range of uses. They show no softening with increasing temperature up to the point where the oil actually distills from the gelled mixture, or burns; they stand up well under shearing stress, and those prepared from fuller's earth give outstanding corrosion protection and resist breakdown by oxidation. With properly prepared grease, moreover, there is no increase in bearing wear over that shown by the usual soap-thickened greases. The new types, although not yet fully developed, are probably the nearest approach to a multipurpose grease now available.

Both the silica aerogel and the bentonite-type thickening agents are on the market now. They are, however, rather expensive and have been used only where top performance is required. Colloidal fuller's earth, by contrast, has proved equally as effective as the others and may be substantially cheaper. Its use, the article concludes, is expected to expand applications for the solids-thickened greases much more widely in the future.

Automatic Factory

THE day of the automatic factory is steadily advancing, according to the September, 1953, issue of Stanford Research Institute's news bulletin, "Research for Industry."

Within the next ten years, it is pointed out, manufacturing methods in the electronic industry can be expected to go through an extreme evolution. Increasing labor costs, the desire for more and better things for living, and the need to make the best use of every bit of raw-material resources make it almost mandatory that the electronics industry turn to automatic factories.

The bulletin reports SRI's progress after three years' work on development of automatic production techniques for electronic equipment. Undertaken for the U. S. Air Force, SRI's program has studied nearly all existing construction techniques and has experimented with an automatic production line of its own design. Current findings indicate that a system using functional, interchangeable units will be most flexible and economical.

Major aspects of the design of a complete line have been worked out on paper. Experimental effort to date has been concentrated on five main operations and problem areas:

1 Selection of an etching solution for optimum etching time in making circuit base plates; regeneration of the etchant and recovery of copper etched from the plates.

2 Development and application of a wax flux to resist the etchant to form the circuit pattern on the base plate.

3 Application and positioning of mask for spraying the etchant resist on the plate.

4 Design and evaluation of the component-attaching machine.

5 Construction of trial assemblies to show typical products of the experimental automatic line and to check performance and packaging considerations.

As designed by engineers of the Institute's Advanced Techniques Laboratory, the automatic production line could turn out approximately ten 5-tube electronic subassemblies per minute.

In SRI's automatic assembly, an etched circuit on a flat plate replaces complicated hand-wiring. By this method, a chemical-resistant coating is automatically sprayed through a stencil or printed through a screen onto a foil-covered base plate. Immersing the plate in an acid bath eats away the unprotected metal, leaving the circuit pattern intact.

Institute improvements of the technique have lowered the

etching time to 30 sec as compared with 3 to 11 min previously required.

SRI's research on attaching resistors and capacitors in the circuit has resulted in a machine which can align and attach these components at a rate of 0.4 sec for each item.

Institute engineers point out that increased demands by military, industrial, and home users boosted last year's production of electronic devices to the $6 billion mark—a 50 per cent increase over peak wartime production. Working with this output, the engineers say, the automatic production line could improve quality control and reliability, minimize waste, and bring a reduction in manpower costs.

Another argument for automatic assembly is the fact that hand-assembly methods could not produce enough electronic equipment for an all-out emergency. Mechanized production of guided missiles, communications, proximity fuses, electronic fire control, and other devices is necessary.

For the successful automatic factory, the bulletin states, the end product must be designed to fit the fabrication method. The industrial machine designer, the materials-processing engineer, and the electronics engineer must collaborate closely to realize the potential boost that electronics offers to our national productivity.

Aluminum Skyscraper

THE 410-ft 30-story Alcoa Building, America's first aluminum skyscraper, was dedicated recently in Pittsburgh, Pa., by Aluminum Company of America, marking completion of the lightest building for its size ever built. For an exterior view of the building see frontispiece on page 862 of this issue.

Begun in May, 1950, the Alcoa Building claims numerous building innovations. Its exterior walls are sheathed with hundreds of aluminum panels. Its aluminum windows are reversed for cleaning from inside the building; weather is kept out by means of an inflatable rubber tube recessed in the window's aluminum frame. Completely air-conditioned, the building's offices are heated and cooled from aluminum ceilings. All electrical wiring and most of the plumbing is aluminum, as are lighting fixtures, elevator cabs, partition framing, and many thousands of pounds of interior trim.

ALUMINUM PANELS

The aluminum panels, which sheath the building in a continuous run, are $\frac{1}{8}$ in. thick and were mechanically stamped in a huge hydraulic press. Individual panels measure roughly 6 × 12 ft, the top half containing a 4-ft 2-in. × 4-ft 7-in. cutout for the insertion of a reversible, aluminum-framed window. The bottom of each panel is depressed into an architecturally pleasing, inverted-pyramid pattern about 7 in. deep.

The panels were given an electrochemical finish, to build up aluminum's natural oxide coating. A silicon-bearing alloy liner in the sheet itself, combined with this anodizing process, gave them a permanently iridescent gray color.

Complete with window frames installed, the panels were stored on each floor until ready for installation.

Before attaching the panels to the building frame, metal clip angles were first bolted to the spandrel beams. Then, the one-story-high panels, being lowered into place from the floor above, were quickly bolted to the angles. Once this procedure had been worked out on a few floors, installation went ahead rapidly. Panels were shimmed into final position by screw jacks. Holes had been drilled in the flanged sides of the panels enabling workmen to bring panels into proper elevation with a minimum of delay.

Once the aluminum "skin" had been properly anchored to the spandrel beams on each floor, erection crews moved upward. Panels were engineered so that no taping or calking of joints was required—a costly maintenance factor in masonry buildings. Flanges of panels were designed so that a four-way labyrinth excluded all rain penetration. Structural-steel columns were covered with smaller, 27-in-wide panels extending from floor level to floor level at 20-ft intervals around the perimeter of the building. Separated from its backup wall, the thin exterior-wall design permits circulating air to help carry off water vapor that may penetrate from the interior of the building.

No expensive scaffolding was required to install the panels; all installation was effected from within the building. Floors were quickly and completely enclosed without delays occasioned by bad weather. Because of their relatively large size and few joints, panels were installed in a fraction of the time required for "wet" or masonry construction that must be built up laboriously piece by piece.

The inner "backup" wall of the building (except for window openings) extends in an uninterrupted plane from column to column, beam to beam.

REVERSIBLE WINDOWS

At the outset of design work on the structure, one rigid specification was established; windows would be designed to pivot so that they could be washed from within the building.

The windows are set directly into the curtain-wall panels. Frames were fabricated from aluminum extrusions, anodized in a natural-color finish which provides a pleasing contrast to the medium-gray patina of the curtain wall. Sash is double-glazed, a job that was done after each panel was permanently bolted in place.

Pivoting, on a vertical axis, a full 360 deg, the window is designed to be washed from within the building without recourse to outside hooks, safety belts, or precarious perches. Window corners are rounded to simplify the cleaning task. The exterior pane is heat-absorbing, glare-reducing plate glass, measuring $\frac{1}{4}$ in. thick. Then comes a $\frac{1}{2}$-in. sealed air space, and finally a pane of clear, $\frac{1}{4}$-in-thick plate glass.

Recessed in the frame's outer edge is a long-lived but replaceable natural-rubber gasket which is inflated to a pressure of about 30 lb, much like a bicycle tire. Window-cleaners' carts are equipped with a Y-shaped tool connected by rubber hose to a portable compressor which deflates and inflates window gaskets before and after the cleaning operation.

A special key unlocks the window, locks it again after cleaning. And, since the building is completely air-conditioned, windows need be opened only for cleaning. Designed to withstand all the weather extremes of a northern winter, the reversible windows have already undergone accelerated tests against driving rain and winds of hurricane force. No leakage, structural damage, or moisture penetration has resulted.

FIRE-RATED BACKUP WALL

As novel and as practical as the building's aluminum sheathing is the structure's fire-rated backup wall. Not a conventional inner wall, it is a thin, self-supporting lightweight barrier to fire, sound, and heat loss. Erected from within the building after the facing panels of aluminum were installed, the backup wall was literally "sprayed" into place.

First, slotted aluminum lath was set up as a form to receive the lightweight concrete inner wall. Metal reinforcing bars were simultaneously put in place. Next, a four-man crew sprayed perlite concrete from a pneumatic nozzle onto the aluminum lath, after having first masked out window areas. Four separate, 1-in-thick passes were made on the walls, the perlite hardening after each application before the next layer

was applied. Experience soon showed that three of these four-man crews were able to complete backup walls of the building at the rate of about four floors a week.

Total weight of the building's installed backup wall is only 66 lb per cut ft, less than half the weight of traditional building construction.

FIG. 8 ALUMINUM CURTAIN-WALL PANELS SHOWN BEING INSTALLED FROM INSIDE BUILDING

(They were bolted to metal brackets on spandrel beams, need no calking or periodic maintenance, are self-cleaning.)

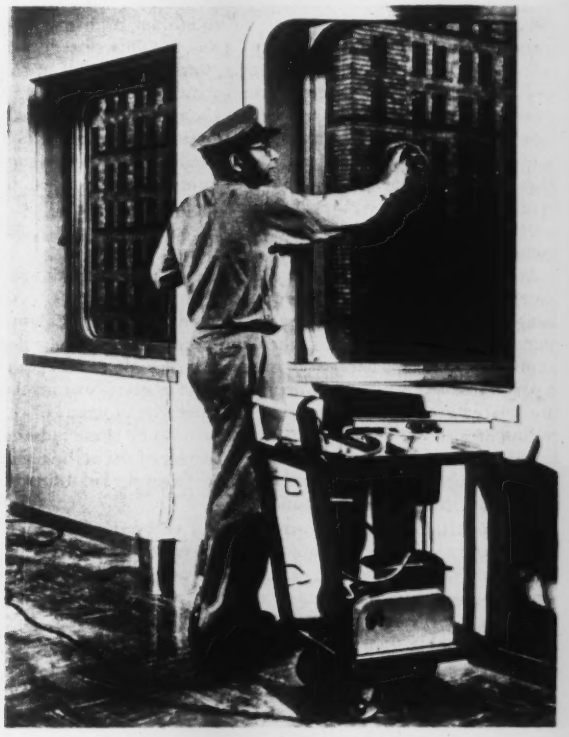


FIG. 9 DOUBLE-GLAZED WINDOWS, SET IN EXTRUDED ALUMINUM FRAMES, REVERSE FOR CLEANING

(Special compressor in foreground deflates, inflates rubber tube before and after cleaning operation.)

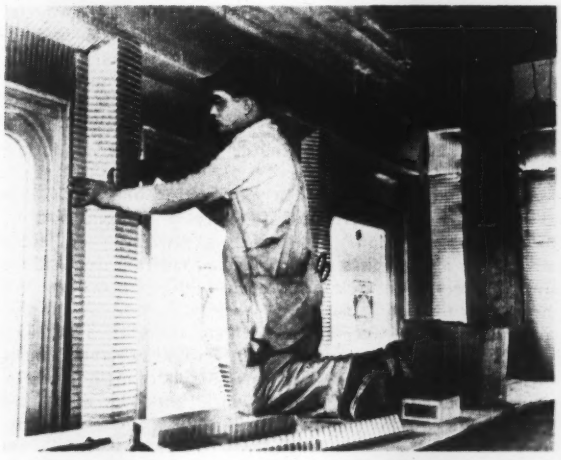


FIG. 10 EXPANDED ALUMINUM LATH FORMS INTEGRAL PART OF BACKUP WALL IN ALCOA BUILDING

(Perlite concrete is applied to lath to form lightweight fire-resistant inner wall.)

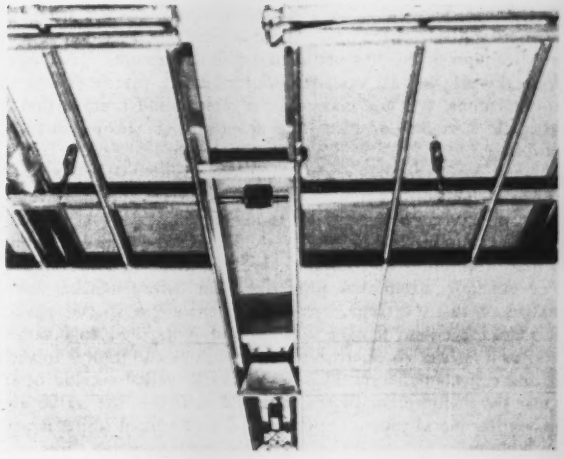


FIG. 11 RECESSED ALUMINUM LIGHTING FIXTURES ARE INTEGRAL PART OF ALUMINUM CEILING

(Heating and cooling are provided by 6 × 12-ft grids of $\frac{1}{2}$-in. aluminum pipes.)

CEILING COOLING AND HEATING

Another innovation is the unique overhead radiant-heating and cooling system in the ceilings of the structure.

Save for machine rooms and odd spaces, the building is heated and partly cooled by a network of aluminum piping which heats or cools thousands of ceiling "pans." This system provides all of the heat needed in winter, and at least half of the cooling required in the hottest summer months.

Suspended to proper elevation from the main ceiling on each floor are a series of 6 × 12-ft grids of aluminum pipe into which hot or cold water is circulated, depending on the season. These grids, comprised of $^1/_2$-in. aluminum pipe welded to headers on 1-ft centers, are supported by a turnbuckle-leveling system which holds them precisely above ceiling level. All connections are fitted with flared-type joints.

Attached to the ceiling grids are a series of aluminum radiant panels, measuring 1 × 2 ft and 0.040 in. in thickness. An integral part of the ceiling, they are clipped to the $^1/_2$-in. aluminum pipe by a simple, continuous-type grid. Purely for acoustical reasons, 9 per cent of the area of each aluminum panel is perforated and a $^3/_4$-in. semirigid blanket of glass-fiber insulation placed atop the ceiling grid. Almost three fourths of the ceiling area of the entire building is taken up by these radiant-heating-type aluminum grids; the remainder of the ceiling area contains flush-type fluorescent lighting fixtures, air diffusers, return-air grilles, and access panels.

Recessed lighting units form a part of the ceiling's radiant surface and are in direct contact with the grid pipes.

Since no radiators, pipes, cabinets, heaters, or other types of along-the-wall air-conditioning units are used, approximately 15,000 sq ft—the equivalent of $1^1/_2$ entire floors of space—were gained in usable floor area by employing this radiant-ceiling system.

In summer the Alcoa Building's main source of cooling and dehumidification are two motor-driven refrigerating machines located in the basement. This equipment operates with condensing water chilled in a huge aluminum cooling tower atop the building. A sort of central "refrigerator," the tower chills water pumped to air-conditioning units on each floor.

ALUMINUM PLUMBING

The aluminum piping in the new building incorporates some established doctrine along with many new and a few hitherto untried applications in the plumbing field. About 60 per cent of all piping in the 30-story structure is aluminum. It is used, for example, for all domestic water-supply piping, risers to toilet rooms, and for many of the valves and fittings in the gigantic network of plumbing installations throughout the building.

Anticipating the day when aluminum piping will become useful in all phases of plumbing, Alcoa engineers specified aluminum pipe wherever practical and economical. A "sacrificial" aluminum-pipe fitting is used throughout the building where aluminum and copper pipe are used in combination. For example, aluminum pipe ends just before flanged water valves on many fittings. At such junctions, a special gasket is placed between flanges and around bolts, and this gasket acts as a barrier to electrolytic corrosion at the joint. In such connections, further, a 13-in-long, thick-walled section of almost pure aluminum pipe is inserted between the valve and dissimilar metal pipe. Aptly named a sacrificial joint, it acts as a magnet to attract electrolytic current away from the aluminum and dissimilar metal pipe, and thus limits possible corrosion to itself. There are more than 650 of these protector-pipe inserts in the building, all accessible for easy replacement when necessary.

FIG. 12 MOST OF THE ALCOA BUILDING'S PLUMBING IS ALUMINUM (These large valves are wholly fabricated in aluminum. In addition, all electric wiring and lighting fixtures are aluminum.)

Aluminum-pipe connections in the plumbing system are either welded or have flanged connections. They are joined by heli-arc welding. Piping work in the building was accomplished without undue difficulty, in spite of the fact that Alcoa's building is the first to utilize aluminum piping on such a large scale.

Automotive Combustion

RESEARCH on engine combustion at the National Bureau of Standards is providing much valuable information on the chemical processes which take place within the cylinders of an automotive engine during the combustion cycle. By use of a very fast-acting valve previously developed by NBS, it has been possible to take samples of the rapidly changing combustion gas over extremely short intervals. Analysis of these samples has yielded detailed knowledge of the proportions of reactants and products present at various stages of the cycle. The data thus obtained provide a basis for increased understanding of the mechanism of engine knock and carbon formation in the cylinders.

As the compression ratios of modern gasoline engines are continually raised, increasing difficulty is being caused by knock and preignition. The rapidly expanding use of diesel engines has also emphasized problems of cold starting and engine roughness and smoking under heavy-load operation. All these difficulties are associated with the combustion phenomenon known as autoignition, which occurs when a fuel-air mixture is heated by compression until it ignites spontaneously without spark. Fuel injected into the hot air in a diesel cylinder ignites by this process, while knock in a gasoline engine is caused by explosive autoignition of the last, unburned portion of the fuel-air mixture to be traversed by the normal flame from the spark plug.

Seeking information that will lead to more efficient utilization of fuels, the NBS engine fuels laboratory has conducted an intensive investigation of autoignition. The apparatus in-

cludes a special single-cylinder engine of variable compression ratio in which a wide range of operating conditions may be simulated. The engine has been modified to permit the compression-ignition of a single homogeneous premixed charge of fuel and air in the absence of burned residual gases, cylinder hot spots, and lubricating oil. Pressure, rate of change of pressure, and light emission are oscillographically recorded as functions of crank angle or time. At any preselected time during the course of the reaction, the special sampling valve can be used to remove a sample from the reacting mixture during an interval of about 0.2 to 0.3 millisecond. Use of this valve enables the reaction to be followed by mass spectrometric means.

Experiments have been carried out in the single-cylinder engine on a number of hydrocarbon fuels of various chemical structures. In general, it has been found that the autoignition of a paraffinic hydrocarbon occurs in a series of steps. The first detectable reaction is the formation of peroxides at a temperature between 600 and 800 F. At a somewhat higher temperature, after peroxide concentration has become appreciable, a blue luminescence called the cool flame appears, accompanied by a substantial increase in temperature and pressure. When the temperature has risen to about 1100 F, the rate of reaction suddenly increases at a rapid rate as the hot flame begins. The accompanying violent pressure rise initiates a pressure wave which is reflected back and forth across the combustion space, causing audible knock.

Investigation of many pure hydrocarbons, iso-octane-n-heptane blends, and oxygen-containing compounds has shown that as octane number and resistance to autoignition increase, the temperatures at which peroxides and cool flames are first detected also increase while the amount of heat released during the cool flame decreases. Over a wide range of fuel-air ratios, however, the temperatures at which hot flames first appear lie in the same temperature range—1100 F ± 50 F—for all aliphatic compounds studied. Because the octane numbers and autoignition resistances of the fuels investigated vary widely, these properties are thought to be functions of the extent of "self-heating" in the early stages of the reaction. According to this view of the over-all process, a very high-octane fuel must be heated by compression alone to nearly 1100 F before hot flames begin, whereas a low-octane fuel may contribute several hundred degrees of the required temperature rise by its own early reactions. Thus, the ease with which low-octane fuel autoignites is probably due to the large contribution of the cool-flame reactions in raising the mixture temperature to the necessary 1100 F. The fact that the hot-flame stage of combustion begins at very nearly the same temperature for all fuels may indicate that this stage takes place as the result of the production of a single essential intermediate compound during the earlier stages of reaction. Or perhaps the reactions which occur are common to all the fuels studied.

While n-hexane was being used as a fuel in the variable-compression engine, eight samples of the combustion gas were removed and analyzed in the mass spectrometer. Mixture composition was then plotted as a function of time during autoignition. When a lean mixture was used, no large change in chemical composition occurred between the start of peroxidation and the beginning of intense cool flames. During the cool flame, however, the hexane decomposed into several olefins, acetylene formaldehyde, carbon monoxide, carbon dioxide, and water. By the time the hot flame began, only about one third of the hexane had decomposed, and this small amount of fuel had undergone sufficient oxidative degradation to cause a temperature rise of about 450 F. In the early part of the hot flame most of the original fuel and fragments, including formaldehyde, were decomposed, while hydrogen and acetylene were formed in large quantities along with small amounts of diolefins and benzene.

Other sample analyses made with a series of branched and cyclic paraffins show that these fuels all produce olefins, carbon oxides, and water during the early reactions. The lower-octane fuels give larger quantities of these products and, in addition, produce formaldehyde and acetylene during the cool flame.

The rapid increase of acetylene (C_2H_2) concentration in the hot flame is one of several pieces of information which tend to corroborate results obtained in the past year. These results suggest that acetylene is an important intermediate in the hot-flame combustion of hydrocarbons. Work now is being carried on at NBS to determine the part played by acetylene in the earlier stages of combustion.

There is also considerable evidence, both from the NBS studies and from those in other laboratories, that acetylene may be the essential intermediate in carbon formation in burning mixtures. Carbon is readily formed in knocking combustion in engines, even with lean mixtures, and this may indicate that the formation of carbon from the acetylene present is a faster reaction than the direct oxidation of acetylene under these conditions.

Plastic-Metal Laminate

A method of laminating vinyl plastic and sheet steel or aluminum which will make these metals colorful, decorative, and permanently rust and corrosionproof has been developed by the Naugatuck Chemical Division, United States Rubber Company, New York, N. Y.

The process combines the structural strength of metal with the bright colors and exceptional corrosion resistance of vinyl plastic. It is believed to be one of the most significant advances for the metals and plastics industries in the last decade. Already more than 20 manufacturers of containers, business machines, chemicals, metals, and allied products are experimenting with the process.

Some of the products which can be made from the plastic-metal laminate are decorative and weatherproof building siding, interior paneling, colorful lawn furniture, office and industrial machine housings, inexpensive corrosion-resistant containers for chemicals, chemical piping and ducts, truck and trailer-body panels, counter tops, shelving and lockers, and office furniture.

The bonding of Marvinol, Naugatuck's vinyl, to sheet steel or aluminum yields a laminate, called Marvinol-Metal Laminate, claimed to have a higher abrasion resistance than varnish, paint, and baked-enamel finishes. The laminate can be sheared, drilled, or punched, without chipping. In addition, the bond of the plastic to the metal is so strong that 180-deg bends and deep draws can be made without separating the vinyl from the metal.

There are no special techniques required, and the only limitation in fabrication is that soldering, welding, or brazing cannot be used without removing the coating for a short distance on either side of the seam. However, the company adds, joints and exposed metal at cut edges can be protected by pressure-sensitive tape or coatings of high-molecular-weight Marvinol vinyl resin in special solvents, applied to exposed areas during fabrication.

The cost of the laminate is higher than galvanized iron, but only about $^1/_3$ the cost of comparable-gage stainless steel.

The laminate is made by rolling, under low pressure, rigid or semirigid Marvinol vinyl sheet onto heated adhesive-coated metal strips or sheets. Adhesion is then effected in seconds

under heat lamps or another suitable heat source. Secret of the process lies in the use of a special adhesive and proper preparation of the metal and the vinyl-plastic compound. It is a process which, according to company claims, can be adapted easily to high-speed production for fabricating either continuous rolls or individual panels. To date, cold-rolled steel, hot-rolled pickled steel, and aluminum, from 18 to 34 gage, have been used to make the laminate. The vinyl films used have ranged from 0.002 to 0.02 in. thick.

Tests on the finished laminate indicate an adhesion in excess of 40 psi of width, permitting the laminate to be fabricated with all types of regular metal-forming equipment without damage to the coating.

In a series of corrosion tests, laminated panels have been left outdoors for two years without breakdown. Ducting made from the laminate has carried sulphuric and nitric-acid fumes for a year without deterioration.

In other tests, panels have been exposed to 100 per cent humidity at 160 F for 1000 hr without adhesion failure or blistering, and with only slight color changes. Oven aging at 150 F for 600 hr had no perceptible effect on adhesion or color.

A patent has been applied for, and Naugatuck Chemical Divison intends to make this laminating process available to industry.

TV Picture Tubes

THE period of adolescence of the television picture-tube industry has been a short one, according to an article in the September, 1953, issue of *Westinghouse Engineer*. In 1946, the first year of commercial television broadcast, about 100,000 tubes were produced—this has ballooned to an estimated 8 million this year. Furthermore, in 1946, there were approximately 10 manufacturers of television picture tubes. Today there are at least 30 companies producing cathode-ray TV tubes.

The cathode-ray television tube is a precision device. Tolerances of as small as 0.0007 in. must be maintained for some spacings of the electron-gun assembly. Chemical purity of the fluorescent screen for some metal contaminants is held to one part in 25 million. Moreover, these stiff requirements must be met in large-scale production lines.

The production line consists of a series of semiautomatic machines, with endless conveyers carrying tubes from one operation to the next, at a rate of 16 fpm. Theoretically, a tube could be manufactured, tested, and packed in six hours.

The inside of an electron tube must be immaculate. The slightest bit of dirt or rust would result in liberated gas after the tube is sealed and cause low cathode emission, i.e., unsatisfactory light output. Every piece that goes into the tube must be treated to remove grease and prevent corrosion. Small parts such as the electrodes are heated to 1000 C in an atmosphere of hydrogen. Hydrogen is used because it reduces the oxides and diffuses out of the metal readily during final tube exhaust.

Two types of metal have proved satisfactory for the metal cone, chrome iron and vitreous enameling iron. Both types are cleaned by degreasing and sandblasting. The iron cone is then dipped in an aqueous alkali-nitrate. This blackens the metal surface with a layer of iron oxide, which resists rust formation and oxide flaking.

Metal areas to be joined with glass are sprayed with a high-temperature enamel which controls the thickness of iron oxide when the metal is heated. The enamel acts as a wetting agent for the glass during the glass-sealing operation and provides an intermediate bond between metal and glass.

The initial steps are the sealing of the glass funnel neck and the face plate to the metal cone to form a bulb assembly. The glass and metal are quickly heated to approximately 1850 F and the surfaces are slowly fused together. The enamel and glass fuse to the metal simultaneously.

From this point on, the bulb assembly is hung on a continuous conveyer belt. If a tube should get past an operator the first time around, it circles and can be picked off when it reappears.

The bulb is washed thoroughly with caustic soda or ammonium bifluoride solutions to clean thoroughly the interior of the bulb, then placed in a face-down position and partially filled with an electrolyte solution, to which a phosphor material is added. The phosphor settles out of the solution to the face plate. After 30 min the tube is slowly tilted to remove the suspension liquids. This screen-coating operation is extremely sensitive to chemical contamination and mechanical vibration. Phosphors are adversely affected by as little as one part per several million of metallic contaminants. The temperature of the settling solution and the room must be accurately controlled, since proper distribution of the phosphor on the tube face depends on its being carried to the edges by convection currents. The final screen must be uniform in thickness and weight (4.3 to 6.0 mg per sq cm) in order to give proper color and brightness. The bulb is air-dried and the screen is inspected.

All of the bulb interior except the phosphor screen is painted with a graphite-silicate conductive coating that serves as a high-voltage anode and collector for secondary electrons emitted by the phosphor. This coating is dried (viewing face is turned up) with hot air.

The bulb is now placed in an indirectly gas-fired 100-ft lehr oven. As the bulb moves through the oven on a continuous belt, it is baked for 105 min, reaching a maximum temperature of about 400 C. This removes water vapor and other volatile impurities from the bulb, screen, and internal coating. After baking, the bulb is inspected under ultraviolet light and any defective screens are returned to be washed and rescreened.

At the mount-sealing machine, the gun assembly is sealed into the neck of the tube. Manufacture of the gun is another process in itself. The major portion of handwork required in the manufacture of a cathode-ray tube goes into the gun. Filament, grid, screen grid, anode, and focusing electrodes are assembled in jigs and fixed in position with wire studs imbedded in Pyrex glass. The assembly is then welded to a glass stem containing supporting and connecting lead wires. The mount-sealing machine fuses the glass neck of the bulb assembly to the stem.

The stem tubulation allows air to be evacuated from the bulb. The tube is placed on an exhaust machine. While being evacuated, the bulb is heated gradually to about 400 C. At the same time the metal gun parts are radiofrequency-heated to remove absorbed gases in the metal.

The bulb is cooled slowly at a predetermined rate so that the most favorable mechanical stress conditions exist in the metal-glass bulb. At the final exhaust position, the tube is sealed off by melting the glass tubulation while the tube is still being evacuated. A base is cemented on the neck end of the bulb and the leads are soldered into the base pins.

After sealing-off, the getter is heated, evaporating barium metal within the tube. Barium reacts with any gas molecules liberated during sealing-off and further improves the vacuum.

The completed tube is "seasoned" for one half to three quarters of an hour by applying voltages to the elements to stabilize the tube characteristics. Every tube is given a 100 per cent electrical and mechanical test.

Finally, each tube is painted on the outside. The metal cone is given an insulating coating that prevents breakdown between the metal shell operating at high voltage and the deflection coil operating near ground potential.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Industrial Instruments

A Buoyancy-Type Liquid-Metering Unit, by W. C. Stickney, Pittsburgh, Pa. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-6** (mimeographed).

THE need for a simple, reliable liquid-weighing device developed as demands increased for more accurate data on fuel consumption during internal-combustion tests. This paper describes a buoyancy-type liquid meter built for this purpose. The physical requirements, basic considerations that led to its development, and description of its operation are covered. Operating as a batch-weighing device, the weigher can control several simultaneous variables, as totalizing the engine revolutions and volume units of combustion air used with a predetermined weight of fuel. Although the physical requirements of the meter described were somewhat limited, the principle may be found applicable over a wide range of weighing operations and flow rates, and for greater accuracy where desired.

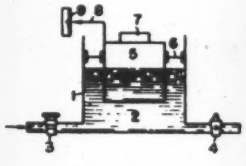
The buoyancy-type meter makes use of a very simple principle long known to the science of physics. Any body immersed in a liquid experiences a certain buoyant force because of the fact that the average upward pressure on the body is greater than the average downward pressure on it. If the buoyant force is equal to the weight of the body, then the body will remain in equilibrium and float about in the liquid. The application of Archimedes' principle of floating bodies establishes the axiom that the weight of the liquid displaced by the floating body is equal to the weight of the body. It is therefore possible to weigh a known quantity of liquid by a very elementary application of this principle. For illustration of the principle, consider a reservoir filled to the overflow point with liquid, a float in the reservoir freely floating in the liquid, and an overflow or catch basin to collect the overflow liquid when a known weight is applied to the float. The application of a known weight to the float will deliver to the overflow a weight of liquid equivalent to the weight applied.

The buoyancy method of weighing is a variation in application of the principle and uses a float with a short but limited travel and means of applying weight to it to make it buoyant at two different levels of immersion in liquid. Fluid measured between these two levels is proportional to the applied weight. The accompanying illustration shows the general arrangement of the system, with a weight 7 on the float and liquid being admitted through valve 3 until the float rises to its indicated null point. Valve 3 is then closed and, with the weight removed (right figure), valve 4 is opened. Here, fluid is removed until the float falls to its indicated null point, and valve 4 is closed. The quantity of liquid passing through valve 4 is proportional to the weight which was applied to the float.

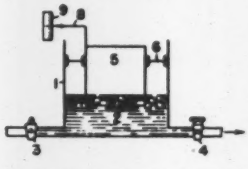
Processing and Proportioning Materials by Weight, by Enrico Klein, Richardson Scale Company, Clifton, N. J. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-2** (mimeographed).

A DISCUSSION of the possibilities of exact processing and batching of ingredients as a means toward the achievement of uniformity and economy of production and a cleaner plant is presented, and the role of self-supervising machines and complex control circuitry is described.

Automatic weighing can be applied to materials handling with great versatility to comply with the exacting process requirements of modern industry. Auto-



FILLING THE RESERVOIR



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matic scales for bulk, bagging, and proportioning purposes have evolved from semiautomatic and gravity-actuated devices to complex electromechanical machines. Sequentially controlled, heavy-duty equipment insures the consistent and accurate delivery of exact quantities of ingredients to brick presses, continuous glass furnaces, metallurgical processes, dryers and mixers for agricultural products, chemicals, abrasives, animal feeds, and almost any other industrial product produced through the compounding of raw materials according to exact formulas. Co-ordinated controls and refinements in monitoring and interlocks bring materials handling by weight in line with the modern trend toward automation.

Wide use is made of closed-loop servomechanisms, an example being the servo-actuated dial follower which transfers a measurement by a dormant weighment within a scale to a proportional weighing machine, and of programming and memory devices. The extensive applicability of certain types of computers is envisioned.

Solids Flow and Level Measurement by Continuous Weighing, by R. H. Berg, Process Control Services, Co., Elmhurst, Ill. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-14** (mimeographed).

THE increasing use of continuous processing for solids brings out many problems in measurement and control. Of prime importance are problems in flow-rate and level measurement. Major applications and general means for measurement are discussed, with specific analyses of techniques and design features requiring further development and improvement. Conclusions indicate that the attainment of these desired developments will aid greatly in establishing, in solids processing, the degree of automatic control now common in the processing of fluids.

In general, continuous weighing is the most feasible means for quantitative measurements of solids and has the advantage of providing accurate measurement without inherently placing the measuring elements in direct contact with the process materials. Solids flow and level admit of no convenient phenomena comparable to fluid orifice effects or self-seeking levels. (Although, as finely divided solids are brought to an increasingly fluidized state, these phenomena may be approached.)

To a limited extent, solids-flow rate may be measured volumetrically under appropriate circumstances, by a bucket wheel or conveyer, or by a helical vane hung in a solid-filled vertical duct, which produces a rotational speed signal as the material passes down through the duct. Errors are resultant, however, when the bulk density changes, and build-up due to direct contact with the process material can be a problem. Most often, continuous weighing of a section of constant-speed belt conveyer is the effective means for measuring solids-flow rate.

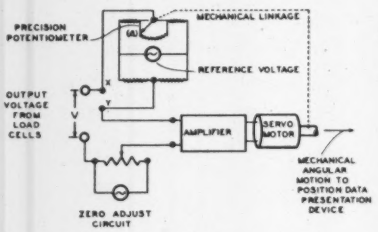
Bin and hopper levels are often measured by mounting pressure-actuated switches in the walls or by inserting probes tipped with special electrical capacitors, audio-range vibrators, or moving paddles (arrested when covered with solids). Again, build-up problem from direct material contact can occur. Also, such units provide little more than single-point level measurement vertically and laterally, and many units must be used to approach continuous, quantitative, accurate knowledge of solids level. Continuous weighing of the hopper and contents provides such knowledge and is quite practical in many instances. For weights over 20 to 30 tons, higher structural costs often must be rationalized with the value of this type of measurement.

At the point of measurement, weight may be sensed and translated into various types of signals: Mechanical, pneumatic, hydraulic, or electrical. This is comparable to the measurement of orifice differentials or tank levels by mechanical, pneumatic, or electrical instruments.

Electronic Weight Determination as a Tool for Control and Measurement Procedures, by V. C. Kennedy, Streeter-Amet Company, Chicago, Ill. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-8** (mimeographed).

IN recent years, electronic weighing techniques have been put to an ever-increasing number of uses. This paper describes typical basic elements used for electronic weight determination and how such elements may be adapted to a wide variety of weighing applications.

Fundamentally, the electronic scale comprises three basic elements. They



ELECTRONIC SCALE SERVO SYSTEM

are the load cells, the servo system, and the data-presentation device. During operation, the weight to be measured is placed on the load cells. The load cells, consisting of small electrical units sensitive to mechanical force, immediately produce an output voltage proportional to the applied weight. This proportional voltage is fed into the servo system which interprets the magnitude of the voltage by automatically adjusting a balancing potentiometer to an equivalent position. At the same time that the servo system positions the potentiometer, it also positions the data-presentation device, (digit wheels in a printer, pointer of a dial, etc.) to a corresponding position. The applied weight on the load cells is then printed and/or visually read out by the data-presentation device.

Proportional Batch-Type Mixer, by L. E. Mylting, Mem. ASME, The Allen-Sherman-Hoff Company, Wynnewood, Pa. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-11** (mimeographed).

THE proportional batch-type mixer is a device which automatically mixes fly ash and water by weight in accurately predetermined proportion.

The weighing device, sketched in the accompanying diagram, is shown in simplified form without any of the devices necessary in its practical application for mixing and recycling. Two materials are mixed in a predetermined proportion by weight, a dry pulverant material in hopper 1 and a liquid in tank 9.

The dry material is fed by rotary feeder 2 through chute 3 into tank 6 suspended at A on weigh beam 7, which in turn is supported by a fixed knife-edge at B. At the other end of the weigh beam at C, to which cylinder 8 is suspended and fastened to the bottom at 8, is the stem of a balanced valve 10 located in the bottom of tank 9 admitting liquid to tank 6 through chute 11. Tank 9 as well as cylinder 8 must be accurate vertical axis cylinders.

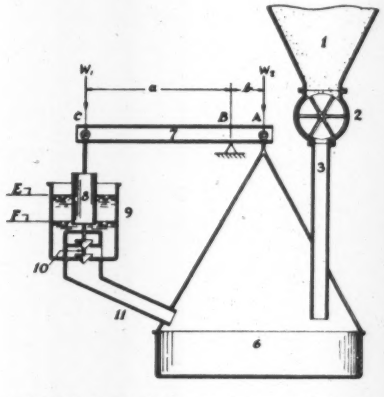
Before a mixing cycle is started, hopper 1 must contain at least enough dry material for a batch of the mixture, and the exact weight of liquid for admixture must be contained in tank 9 between the levels E and F. The distances AB and BC and the diameter of 8 must be proportioned to balance the weight-beam 7, with tank 6 empty, and tank 9 filled to level E.

The cycle is started by rotating feeder 2, which introduces the dry material into tank 6. The weight of this material unbalances weigh-beam 7 opening valve 10, which admits liquid to tank 6.

As the liquid level in 9 drops, the sensible weight of cylinder 8 increases, and unless dry material from 1 is admitted at a sufficient rate to counterbalance the increasing sensible weight of counterpoise 8, then valve 10 will close and no further liquid will be admitted until sufficient additional dust enters 6 to cause again an unbalance, opening valve 10.

If, however, the rate flow of dry material increases, causing further unbalance, valve 10 opens wider and increases the rate of flow of liquid. The weight increments of dry dust entering tank 6 thus control proportional additions of liquid, and any variation in the rate of feed of the dry material produces a corresponding variation in the rate of feed of liquid. The proportion of the dry material to the liquid remains constant during the cycle. When the liquid reaches level F in tank 9, rotary feeder 2 is stopped. Tank 6 is emptied and tank 9 is refilled to level E. The cycle is now completed and conditions are ready for its repetition.

The effect of the weight increments of liquid entering tank 6 has thus far not been considered. The omission has been made in order to simplify the description of the cycle. The weigh-beam 7 is not only in balance at the start of the cycle, but also at its end. The elements of the device are so proportioned that the increase during the cycle in sensible weight of cylinder 8 balances exactly the combined weight of liquid and dry material fed to tank 6. Cylinder 8 and tank 9 are accurate vertical axis cylinders. Hence the change in sensible weight of 8 is in direct proportion to the weight of liquid fed to tank 6, and the effect of this weight can be compensated for permanently by proper proportions in the elements of the device. Any given weight increment of water transferred from tank 9 to tank 6 will furthermore



SCHEMATIC DIAGRAM SHOWING PRINCIPLE OF WEIGHING DEVICE

tend to close valve 10, thus preventing the feed of a small amount of water from unbalancing the cycle by continuing the addition of more water.

Continuous Weighing Meters and Feeders, by J. O. Kirwan and L. E. Demler, Wallace & Tiernan Company, Inc., Newark, N. J. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-9** (mimeographed).

A NEW flowmeter, where the mass rate of flow is measured by determining the torque produced in accelerating the flow, has been developed particularly for measuring free-flowing solid materials. The torque is measured by a pneumatic force-balance system and the flow is indicated, recorded, and totalized by conventional pneumatic receivers.

The application of the new flowmeter and automatic gravimetric feeders and flowmeters of the weigh-belt type to continuous processing is discussed and several typical installations are described.

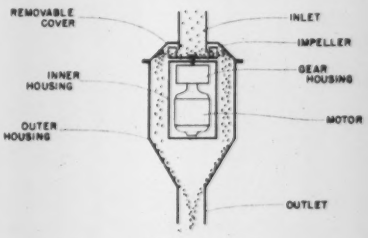
The massometer is a force-balance type of instrument. It is designed to measure the mass rate of flow of free-flowing solids, liquids, or slurries. It resembles a motor-driven centrifugal pump with its axis of rotation in the vertical plane.

The housing is essentially a cylinder within a cylinder. The inner cylinder contains the motor, the geared speed reducer, and most of the force-balancing components. The openings are gasketed to prevent the entrance of dirt and foreign matter. As an extra precaution a small amount of air is bled into this housing so that slight pressurization is maintained at all times. Structural attachments offering a minimum of obstruction to the flow centrally support the inner housing with respect to the outer one. The annular space between the two housings forms a passageway for the material leaving the impeller and conducts the material back into the plant system.

Material entering the massometer for measurement falls onto the center of the impeller. This material has essentially zero horizontal velocity. As it passes through the impeller it is accelerated by the vanes and leaves the impeller with a horizontal tangential velocity equal to the peripheral speed of the impeller. The work done in accelerating this material is the force which is measured. This force bears a linear relationship to the pounds of material passing through the impeller and is independent of density, viscosity, temperature, or atmospheric pressure.

The motor stator and gear housing are supported in ball bearings and so exert a backward torque equal and opposite to the accelerating force. This backward torque is opposed by air pressure acting on a flexible metal bellows and suitable leverage. Pressure is controlled through a valve positioned by a small movement of the motor stator. The leverage previously mentioned is such that 3 to 15 psi pressure on the bellows represents zero to maximum flow. This pressure will operate any conventional penumatic recorder, indicator, or integrator.

The massometer is extremely fast in detecting changes in the rate of flow. This is due to the fact that any one increment of flow is in the impeller for only a small fraction of a second. Other advantages are: (1) Its small size allows installation in crowded quarters, (2) only one moving part is exposed to the material being measured, (3) it is easy to keep clean because of its shape,



SCHEMATIC DIAGRAM OF MASSOMETER

(4) it is simple to install and requires only electric service and compressed air at 30 psi, (5) it may be locked shut to prevent tampering, (6) it is light in weight (approximately 50 lb) and can be handled easily by one man, (7) it can be mounted on a section of vertical 2-in. pipe so that it may be swung in or out of line at will.

Massometers are made having a range of maximum capacity from 25 lb per min to 225 lb per min. Accuracy is within 1 per cent of indicated flow from 100 per cent to 10 per cent of maximum capacity.

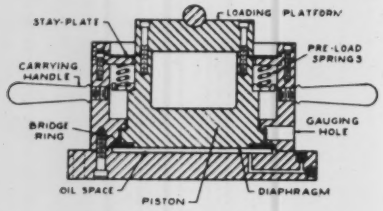
Remote Weight Measurement by Means of Hydraulic Load Cells With Electrical Transmitters, by Joseph J. Hicks, The Chemstrand Corporation, Pensacola, Fla. 1953 ASME Instruments and Regulators Conference paper **53—IRD-4** (mimeographed).

THE increased use of remote centralized control in process industries has emphasized the need for an accurate weight-measuring system which can successfully transmit the weight indication over a distance of several thousand feet. This need was responsible for the development of the weighing system discussed.

It was required that the weight of the

contents of several storage bins, each of 60 tons capacity, be indicated in a central control room 300 yd distant from the point of measurement at the bins in the plant area. The accuracy of the weight measurement should remain unaffected by temperature variations, transmission lag, vibration, corrosion, off-center loading, and windage. Although the initial application required that the signal from the weighing system be capable of providing only an indication or record, the ability to use the weight-measurement signal to control the discharge of the material from the storage bins would offer certain advantages in the process operation.

The system of weighing which has been proposed for this application uses four hydraulic load cells to support each



HYDRAULIC LOAD CELL

storage bin. The hydraulic chamber at the base of each load cell is connected to a Bourdon tube. Variations in hydraulic pressure created by changes in the weight which a load cell is supporting will cause the tip of the Bourdon tube to move. Attached to the tip of each Bourdon tube is the armature of a differentially wound electrical transformer. Motion of the armature within the transformer winding will produce a variation in the voltage output from the transformer. The connections from the four transformers are arranged to provide a single electrical output signal which is indicative of the total weight being applied to the load cells. This electrical signal is transmitted to a receiving indicator where it appears as an unbalanced signal voltage input to an amplifier. It is amplified and used to actuate one phase of a small servo motor. The motor drives a mechanical linkage to position the armature of a similar differential transformer located in the receiver. This action produces a voltage output from the receiver transformer which nullifies the transmitted weight signal and restores electrical balance to the circuit feeding the amplifier. With the circuit in electrical balance, there is no further input signal to the amplifier and consequently no further motion from the servo motor. The action of the servo motor in positioning the armature of the receiving transformer also drives the indicator pointer, or recorder pen, to the proper calibration on a scale or chart. The pointer or pen will remain in this position until a change in load in the storage bin again creates a similar cycle of servo action.

For this application it was desired that the weight of the bin contents be indicated locally in the immediate area where the bins are mounted as well as in the remote central-control room. This feature was achieved in the system design by locating in the local area, the receiving indicator mentioned, and retransmitting to the remote-control room by means of a similar differential transformer operating in tandem with the receiver.

High-Speed Weighing, by N. G. Maloney, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-10** (mimeographed).

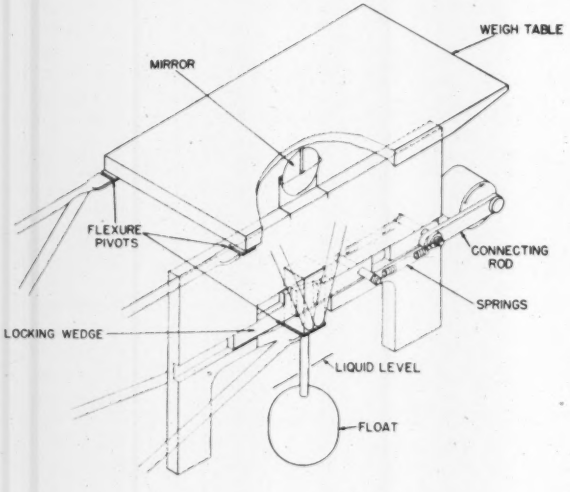
MODERN packaging machines and the laws governing interstate commerce where the net weight is stated on the package, have focused attention on methods of inspection to insure that each package contains the minimum net weight. A research project undertaken to develop methods of high-speed weighing has resulted in a system by which packages were weighed at rates over 300 packages per min with an error of less than 1 per cent.

In the weighing scales developed, the suspension is by flexure pivots designed to be loaded only a few per cent of the endurance limit. Wear is not a problem, and friction resulting from vertical motion is negligible. The required freedom of vertical motion and stiffness in all horizontal directions is achieved by using a three-point suspension at one end of a parallelogram and four suspension points at the other end. The large drag force has little effect on this suspension when the linkage is parallel to the direction of motion.

The float immersed in liquid (mercury) is not only immune to wear but is a direct way to obtain an opposed reference mass in the simplest possible manner without a pulley or other mechanical device. The forces are directly opposed.

As the weigh table and float with the package exceed the buoyant force of the liquid displaced by the float, the entire mass of the system is accelerated by the difference in mass between the liquid displaced and the package with its tare weight of equipment. The increase in buoyant force was purposely kept to a minimum by suspending the float on a small-diameter rod that enters the surface of the liquid. The float was completely immersed and the buoyant force was essentially constant.

A means of locking the weighing table in the up position and releasing it at the proper time with respect to the position of each pallet of the conveyer required considerable care in design. It is important that the article to be weighed and the pallet on which it rides plus the mass of the weighing table and float all be at rest in the vertical plane. The package and conveyer can have the constant velocity they need in the horizontal plane. However, the vertical motion is the criterion of the state of balance between the unknown package with its tare weight of equipment versus the weight of liquid displaced by the float—the reference mass. Any vibration of the locked-up system would result in an initial velocity at the moment of release. The velocity might be in the up or down



SCHEMATIC OF WEIGHING SCALE SHOWING DETAIL OF LOCKING WEDGE AND DRIVING MECHANISM

direction and would seriously influence the distance traveled by the mass-balanced system in the controlled interval of time. A rigid system with a high natural frequency that is not likely to be excited by associated machine speeds is needed to provide the constant datum for weight determination by this means.

Similarly, the detail of the locking device must be controlled so that the release of energy when the weigh table is unlocked is a minimum. Large spring forces that would accelerate the weigh table downward are detrimental, particularly if the spring pressure is not constant. Since engineering materials obey Hooke's law, the release of a clamping pressure is always attended by a release of energy. Therefore the lock-up for the weigh table was designed with a controlled actuating force through a spring and the attempt was made to limit the clamping force, not only in magnitude but also to contain it in a most rigid system of minimum dimensions.

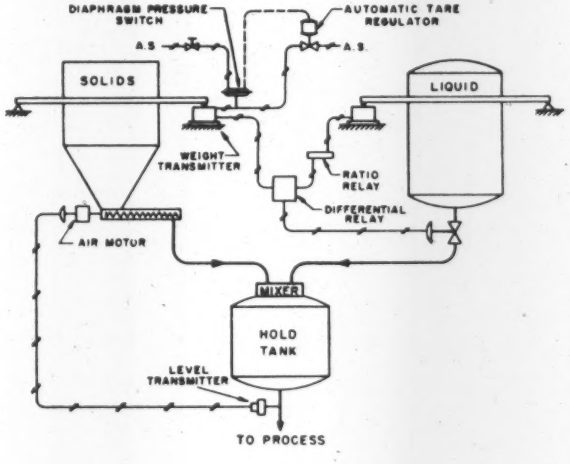
Characteristics of Components in Pneumatic Weighing Systems, by J. W. Milroy and G. C. Mayer, CDC Control Services, Inc., Hatboro, Pa. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-3** (mimeographed).

THE development of pneumatic weighing systems has resulted in the design of new devices and modifications of previously known components to meet the needs of a rapidly growing field. This paper discusses several essential components of a typical system, in the light of design and operational characteristics. It is intended to aid in the proper selection and application of these components for pneumatic weighing systems.

To better understand the application of these various components, consider a typical "loss-of-weight" pneumatic weighing system of the proportioning type. This system is intended to proportion accurately a liquid to a solid on a gravimetric basis and to provide adjustability of the proportioning ratio. A weigh tank, or hopper, is provided for each of the components and each tank in itself is part of a complete batch-weighing system. Omitting the control loops, the paper concerns itself with the operations of proportioning the two materials after having filled the tanks to the correct batch weights. The two streams are fed to a mixer which discharges the resulting slurry to a hold tank for feeding to process. A level control on the hold tank controls the rate of solids discharge to a mixer and maintains a constant head of slurry to process. This system, although shown as a batch type, may well be made continuous by adding two identical tanks which are on a filling cycle while the first pair are on the draining or proportioning cycle.

The heart of the pneumatic weighing system is the weight transmitter, which must provide a pneumatic output signal proportional to the net weight of material in the tanks. Operational requirements of the weight transmitter are that it have: (*a*) A linear output signal, proportional to the applied weight, (*b*) provision for taring out dead weight of the system, (*c*) accuracy and repeatability, (*d*) rapid response to weight changes, (*e*) rugged construction, and (*f*) immunity to dusty atmosphere and accumulation of dirt.

It is pointed out that through the use of available components, properly applied, pneumatic weighing systems are an extremely useful and accurate tool for process control—whether the application be a mere weight-indicating system or a complex, multicomponent, continuous, proportioning system. Although pneumatic weighing systems have been known and used for about six years, the continual inquiries for new and unusual applications point to the need for further exploitation of the process-control field. Some typical applications in the design stage or currently under consideration, are as follows: Continuous multicomponent proportioning of solids, continuous mass-flow control, totalizing throughput of bucket elevator, tensile testing of thin films, platform scales for drum filling and bag weighing, and totalizing throughput of pneumatic conveyer.



LOSS-OF-WEIGHT PROPORTIONING SYSTEM

Bibliography on Bourdon Tubes and Bourdon-Tube Gages, by L. M. Van der Pyl, Mem. ASME, Rockwell Manufacturing Company, Pittsburgh, Pa. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-1** (mimeographed).

THIS bibliography of 143 papers includes all references to Bourdon tubes and pressure gages, annotated and chronologically arranged, published in the period 1849-1952. The invention of the tube, commonly ascribed to Bourdon, appears to have been by Schniz in 1849. Every effort has been made to make the entries complete.

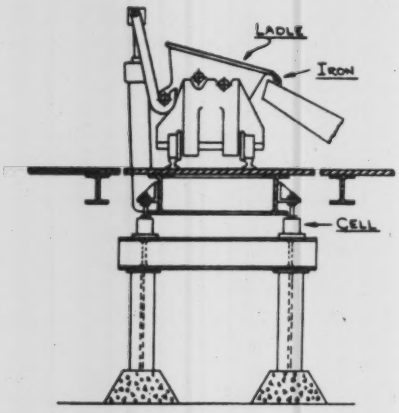
The bibliography was sponsored by the IRD of ASME and was compiled principally by Lyman M. Van der Pyl, chairman of the IRD Bibliography Committee. Credit is also due to G. H. Lee and to P. G. Exline for earlier work on the bibliography, and to S. G. Eskin for particularly helpful suggestions and co-operation.

Electric Weighing in Steel-Mill Processes, by R. J. Carleton, Jr., Gilmore Industries, Inc., Cleveland, Ohio. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-13** (mimeographed).

THE adaptability of electric load cells to weighing applications in the steel industry has led to wide usage at locations proved more difficult, if not impractical, to handle by other weighing means.

Steel-mill installations are described showing the flexibility of design in which electric weighing can serve directly in improving steel-mill operations.

In the past it has been necessary to change or modify mill processes to fit standard weighing equipment. Now, through the use of electric scales, the weighing can be done in the normal manner.



OVERHEAD TRACK SCALE TO WEIGH MOLTEN IRON INTO BESSEMER

The needs for accurate weights are also described as they relate to the output, yield, and efficiency of steel processing. Typical electrical scale applications are described which show the adaptability and flexibility where installations are desired and how it is now possible to weigh steel in process where heretofore it was impractical.

With the growing efforts to improve basic steel processes, the author foresees, open hearths operated to within ±5 tons per heat, ingot pouring to ±100 lb of correct weight, and mills rolling under optimum conditions for complete utilization of all good steel. A new tool is now available with electric scales for utilization by progressive management.

Electric Strain-Cell Weighing, by Lee Barnette, Hercules Power Company, Wilmington, Del. 1953 ASME Instruments and Regulators Conference paper No. **53—IRD-12** (mimeographed).

THIS paper reports results based on several years' experience with plant installations of electric strain-cell weighing. Phases of the subject described include the selection, mounting, field calibration, and typical applications of strain cells. Some instrumentation techniques which have proved satisfactory in strain-cell applications to chemical process are briefly described.

An investigation of the electric strain cell as a primary element for weight measurement in automatic-control systems was undertaken. This work was justified by the fact that bulky mechanical-scale installations, which in addition to being less practical for automatic-control purposes, were almost impossible to maintain in the atmospheric conditions surrounding some chemical processes.

In order to demonstrate that the strain cell is a satisfactory primary measuring element, a test unit, consisting of four Baldwin SR-4 strain cells, was installed under a raw-material tank and electrically connected to an electronic recorder.

An investigation was then made to determine: (1) Whether suitable structural supports could be designed to allow strain cells to give the required accuracy, (2) for what applications they were best suited in the chemical industry, and (3) the feasibility of using automatic control in connection with strain cells.

After careful analysis of the use of strain cells as primary measuring elements for various applications in the chemical industry, it was found that:

The strain cell is temperature-compensated for ambient temperature changes. Temperature changes in a process which would cause errors by expansion or contraction of structure have never been found in application. Therefore the assumption may be made that supporting structures have been correctly designed.

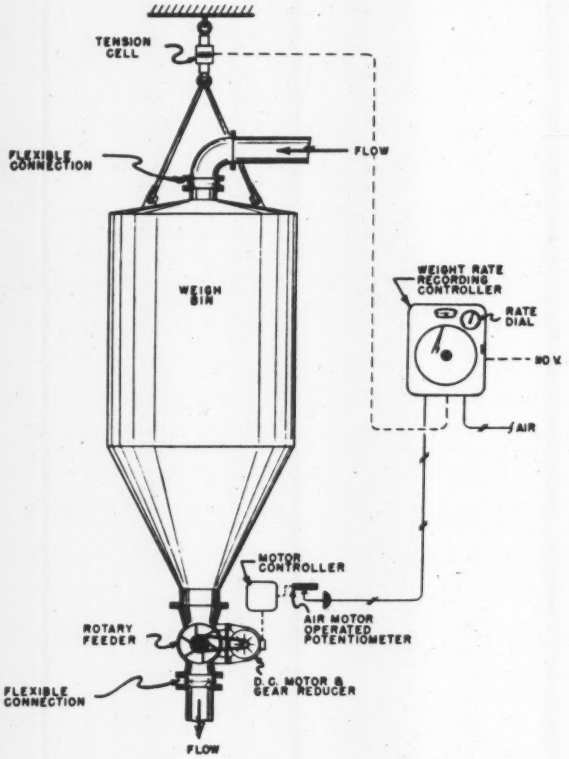
Several cells have been in use for periods exceeding six years and no shifts from zero or full-scale readings have occurred. Several applications have had continuous vibration present, such as agitation in vessel and recycling of heavy slurries. No noticeable effect on cell repeatability or zero shift has been noticed.

Momentary overloads of 20 per cent of total weight have been applied on several occasions when strain cells were used for weighing applications, but no damage resulted.

The cells requiring protection from chemical atmospheres are thoroughly cleaned usually by using steelwool on the surface, and then given two or more coats of Parlon acid-resistant paint. The cells have been in use 3 years and none has been lost to date due to corrosion difficulties.

The repeatability of strain-cell weigh applications has proved to be excellent. Frequent checks made by comparison of known values against the output of the cell have shown them to have better than $^1/_4$ of 1 per cent accuracy.

Flexible and rigid connections have been used successfully. With rigid connections it is necessary in the planning stage to design the piping with maximum



TYPICAL DRY-MATERIAL FEEDER BIN HAVING WEIGHT-RATE CONTROL

flexibility and with minimum loading.

The strain cell, as a primary measuring element for flow, weight, pressure level, and numerous other measurements, has proved to be a precise and flexible tool which should find new applications in chemical industry daily.

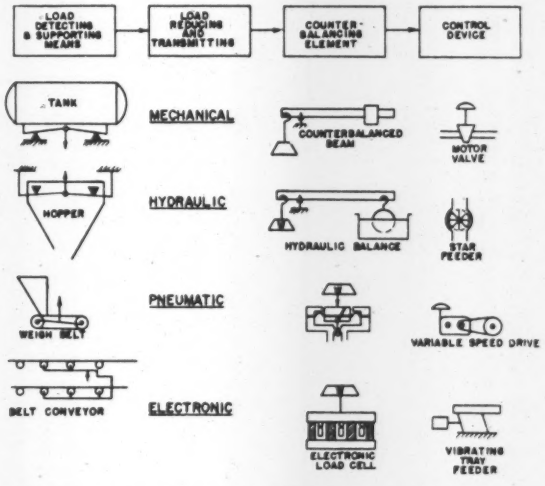
Continuous Gravimetric Proportioning Systems, by R. P. Lowe, Proportioneers, Inc., Providence, R. I. 1953 ASME Instruments and Regulators Conference paper No. 53—IRD-7 (mimeographed).

THE various elements comprising gravimetric proportioning systems and their industrial application are discussed in this paper. Subject matter covers load detecting and supporting means, load reducing and transmitting devices, counterbalancing elements, and control methods. Operation of loss-in-weight system, gravimetric belt feeder, and conveyer scale are described and illustrated by line diagrams and photographs—also application of these units to plant problems.

Continuous gravimetric proportioning may be defined as controlling the weight-rate of a continuous flow of multiple components to a process so that a constant proportionality is maintained. Systems designed to accomplish this are gaining in industrial popularity to such an extent that some understanding of basic principles is needed to guide the engineer in the selection of apparatus and methods best-suited to the solution of a given set of job conditions.

This paper reviews the several basic principles which govern the design and performance of continuous gravimetric proportioning systems. Machines for this service are all basically the same in principle and variations are in the details of control. They consist of four basic elements: (1) Load detecting and supporting means, (2) load reducing and transmitting devices, (3) counterbalancing element, and (4) control device.

Item (1) may be a suspended hopper, tank, or storage cylinder, a weighing platform, or a traveling conveyer belt. Item (2) may consist of a lever system and linkage or a hydraulic, pneumatic, or electronic transmission system. Item (3) may be a mechanically driven or automatic counterbalancing means, a hydraulic or pneumatic force-balance system, or an electronic null-balance device. Item (4) would be a control valve, gate positioner, variable-speed unit for controlling an star feeder, conveyer belt, or a vibrating feed tray.



ELEMENTS OF CONTINUOUS GRAVIMETRIC PROPORTIONING SYSTEMS

Applied Mechanics

Constant-Strain Waves in Strings, by J. D. Cole, California Institute of Technology, Pasadena, Calif., C. B. Dougherty, and J. H. Huth, The Rand Corporation, Santa Monica, Calif. 1953 ASME Semi-Annual Meeting paper No. 53—SA-4 (in type; to be published in the *Journal of Applied Mechanics*).

A NONLINEAR theory is developed for constant-strain waves in elastic strings. The speed of longitudinal and transverse waves is related to the strain and tension. The results can be used to calculate tension resulting from impact and thus breaking loads.

This paper shows how the problem of propagation and reflection of constant-strain waves in an idealized elastic string can be treated. The results are not limited to small deflections. Longitudinal and transverse waves occur which travel with different speeds relative to the string. One limiting case shows how a wave propagates because of elasticity in a string with zero initial tension.

The paper concludes that the results have a practical application in estimating the suddenly applied constant force which will break a rope. An example of this is presented for zero initial tension which shows the nonlinear dependence of tension on force. The results for the idealized string are independent of the cross-section area, so long as the string behaves in a similar manner.

The case of varying velocity applied to a string can be treated by replacing the velocity curve by segments of constant velocity. Then the actual motion can be approximated by various constant-strain waves. Similar problems occur where a load moves as a string.

The Measurement of Acceleration Pulses With the Multifrequency Reed Gage, by Henry Shapiro, Propulsion Research Corporation, Inglewood, Calif., and D. E. Hudson, Mem. ASME, California Institute of Technology, Pasadena, Calif. 1953 ASME Semi-Annual Meeting paper No. 53—SA-8 (in type; to be published in the *Journal of Applied Mechanics*).

IT is shown in this paper that the data recorded by a multifrequency reed gage can be used to derive information concerning the time history of the exciting motion. If the general shape of an exciting acceleration-time pulse is known approximately, then reed-gage data alone will permit calculations of peak acceleration, time duration of pulse, and time to peak acceleration.

A study of response curves for typical pulses will give design data on the proper frequencies, frequency distributions, and damping for the individual elements of the gage.

Response curves for a series of typical pulse shapes are determined by electric-analog-computer methods and are presented in dimensionless form.

Dynamic Stress-Strain Relations for Annealed 2S Aluminum Under Compression Impact, by J. E. Johnson, D. S. Wood, Jun. ASME, and D. S. Clark, Mem. ASME, California Institute of Technology, Pasadena, Calif. 1953 ASME Semi-Annual Meeting paper No. 53—SA-7 (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper presents the results of an experimental study of the stress-strain

relation of annealed 2S aluminum when subjected to compression impact. Two methods of securing a dynamic stress-strain curve are considered, namely, from the measurement of impact stress as a function of maximum plastic strain, and impact stress as a function of the impact velocity.

The dynamic stress-strain curves obtained by these methods lie considerably above the static curve. The elevation in stress of the dynamic relations above the static relation increases progressively from zero at the elastic limit to about 20 per cent at a strain of 4.5 per cent. However, the two dynamic relations are not coincident, which indicates that the behavior of the material cannot be described by a single stress-strain curve for all impact velocities.

A family of stress-strain curves which differ slightly from each other and which depend upon the final strain is postulated in order to correlate both sets of data adequately.

Flexural-Wave Solutions of Coupled Equations Representing the More Exact Theory of Bending, by Julius Miklowitz, Naval Ordnance Test Station, Pasadena, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-6** (in type, to be published in the *Journal of Applied Mechanics*).

THIS paper presents a new method for deriving flexural-wave solutions for the Timoshenko bending theory. The method is based on a breakdown of the total deflection into its bending and shear components. Instead of treating the full Timoshenko equation, an equivalent set of coupled equations, representing the rotational and translatory motions of the beam element, is solved.

Advantages of this method stem from (*a*) the simplicity of the associated expressions for the moment and shear force, which are the elementary bending-theory relations, and (*b*) the well-defined nature of the related boundary conditions. The latter is particularly important since it is difficult to define the proper boundary conditions associated with the full Timoshenko equation. This is evidenced in the works of Uflyand, and Dengler and Goland, both of which are concerned with wave solutions for the infinite beam under the action of a concentrated transverse load. The quoted work points out the erroneous boundary conditions used in the Uflyand work.

The present method is applied to the same case treated in the works. Agreement is shown with the Dengler and Goland solution. The Uflyand solution is shown to have meaning when interpreted properly. The derivation of transforms for other beam cases, both finite and infinite, by the present method has also been included in the present work.

Skin Friction and Heat Transfer for Laminar Boundary-Layer Flow With Variable Properties and Variable Free-Stream Velocity, by S. Levy and R. A. Seban, Mem. ASME, University of California, Berkeley, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-3** (in type; to be published in the *Journal of Applied Mechanics*).

NUMERICAL solutions of the momentum and energy equations are presented for particular types of laminar boundary-layer flow analogous to the Hartree "wedge flows." Variation of the viscosity and of the thermal conductivity is considered under the circumstances of no dissipation, favorable pressure gradient, and the product of conductivity and viscosity a constant. The solution is based on approximate representations of the velocity and temperature profiles in the boundary layer. These are of such character that the labor of calculation is minimized and the accuracy of the results preserved.

The differential equations are reduced to two algebraic equations which rapidly yield the skin friction and the heat transfer in terms of the wall-to-free-stream temperature ratio for the desired value of Prandtl number.

Numerical results are given for a range of wedge flows with gases of Prandtl number 0.70 and 1.0. These results reveal that when the free-stream velocity is variable, the temperature difference between the wall and the free stream exerts a substantial effect on the velocity distribution in the boundary layer and on the skin-friction coefficient. Alternatively, the heat-transfer coefficient is not affected radically.

A calculation method is presented for the determination of the heat transfer and skin friction for a flow with an arbitrary variation of velocity over an isothermal surface. This method utilizes the results of the present analysis for the variable property wedge flows.

The Rate of Growth of Vapor Bubbles in Superheated Water, by Paul Dergarabedian, U. S. Naval Ordnance Test Station, Pasadena, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-10** (in type; to be published in the *Journal of Applied Mechanics*).

CALCULATIONS are presented for the dynamic stability of vapor and air bubbles in superheated water. These calculations indicate that the values of the bubble radii for which the equilibrium is unstable are restricted to a finite range of radii whose values are governed by the temperature of the water and the initial air content in the bubble.

Two theoretical solutions for the rate of growth of these unstable bubbles are considered: (*a*) Solution of the equation of motion of the bubble radius with the assumption that there is no heat diffusion across the bubble wall, (*b*) solution which includes the effect of heat diffusion. The two solutions differ appreciably. These two solutions are then compared with the experimental data on the growth of the vapor bubbles in superheated water. This comparison shows agreement with the solution with the effect of heat diffusion included.

Temperature Distribution in the Wake of a Heated Sphere, by D. H. Baer, Phillips Petroleum Corporation, Bartlesville, Okla., V. J. Berry, Stanolind Oil and Gas Company, Tulsa, Okla., W. G. Schlinger and B. H. Sage, California Institute of Technology, Pasadena, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-2** (in type; to be published in the *Journal of Applied Mechanics*).

THE temperature distribution in the wake of a heated sphere, 0.5 in. diam, was determined in this paper, at a gross stream velocity of 30 fps. Measurements were carried out in a channel 0.70 in. in height and 12 in. in width.

The surface temperature of the sphere and the energy dissipation from it were determined as a function of gross stream velocities between 10 and 90 fps. The temperature distribution in the wake was correlated on the basis of methods developed for cylinders and satisfactory agreement was obtained.

Measurements of Torsional-Stiffness Changes and Instability Due to Tension, Compression, and Bending, by H. L. Engel, Hughes Aircraft Corporation, Culver City, Calif., and J. N. Goodier, Mem ASME, Stanford University, Stanford, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-5** (in type; to be published in the *Journal of Applied Mechanics*).

THE measurements reported in this paper verify theoretically predicted effects of tension, compression, and bending, on the torsional stiffness of uniform bars of thin-walled open section. Related modes of buckling and types of nonlinear behavior in torsion are indicated analytically and exhibited in tests, some of these being apparently new.

On Reinforced Circular Cutouts, by E. Levin, University of California, Los Angeles, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-11** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper discusses a slab with a circular cutout subjected to stresses in the plane of the slab. The cutout has removed material which would have participated in carrying the load. Hence the slab with cutout will fail under the application of stresses which the complete slab could have supported. In order to eliminate at least part of this weakening, the slab with cutout may be reinforced by the addition of material about the cutout. Such a reinforcement may be designed in any shape.

The paper is concerned with extending the results of Weiss, Prager, and Hodge for a cylindrical reinforcement to a reinforcement of arbitrary shape. In particular, a method is described for the determination of a lower bound on the collapse load for a slab with circular cutout and a general reinforcement.

Analysis of a Nonlinear Dynamic Vibration Absorber, by L. A. Pipes, University of California, Los Angeles, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-41** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper presents a mathematical analysis of the action of a dynamic vibration absorber.

The system analyzed consists of a main mass attached to a rigid foundation by a linear spring coupled to the absorber mass by a spring of nonlinear characteristics. The forced oscillations of the system produced by a harmonic disturbing force acting on the main mass are studied analytically. It is assumed that the coupling absorber spring has nonlinear force-displacement characteristics of the hyperbolic-sine type.

Expressions for the amplitudes of the vibrations of the two masses as functions of the frequency of the disturbing force are obtained.

Flexural Vibrations in Uniform Beams According to the Timoshenko Theory, by R. A. Anderson, U. S. Naval Ordnance Test Station, Pasadena, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-9** (in type; to be published in the *Journal of Applied Mechanics*).

IN this paper the general series solution is given for the flexural vibrations in a uniform beam according to the Timoshenko equations, which include the secondary effects of shear and rotatory inertia.

In addition, the series solution is presented for the case of a pin-ended beam.

For the special case of a concentrated transient force at the mid point of a pin-ended beam, the bending-moment and shear-force solutions according to the Timoshenko and elementary equations are compared.

The Effect of Strain Hardening in an Annular Slab, by P. G. Hodge, Jr., Jun. ASME, University of California, Los Angeles, Calif. 1953 ASME Semi-Annual Meeting paper No. **53—SA-20** (in type; to be published in the *Journal of Applied Mechanics*).

A PROCEDURE is outlined in this paper for obtaining the stresses and strains in a circular slab with a cutout, subject to uniform biaxial tension.

An arbitrary stress-strain curve in tension is approximated by any number of straight-line segments. For biaxial states of stress the material is assumed to satisfy a flow law based on the maximum shear stress and to be incompressible throughout. The general equations are given and then simplified by assuming that boundary motions may be neglected if the strains are small, and that elastic strain components may be neglected if the strains are large.

For the case of linear strain hardening a complete solution is given in closed form. If the rate of strain hardening is small, these results may be simplified further, the paper concludes.

Petroleum Mechanical Engineering

Fluid Catalytic Hydroforming Units—Their Mechanical Design, by R. A. Harang, the M. W. Kellogg Company, New York, N. Y. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-2** (mimeographed).

THE need for aviation gasoline during World War II brought about the development of the fluid catalytic-cracking process. In 1941 the first commercial units were placed in operation. Today the fluid process accounts for well over half of all catalytic-cracking capacity.

The improvement of the quality of the gasoline components obtained directly from crude oil has been practiced since the late 1920's when a process known as "naphtha reforming" was developed. By 1939 the fixed-bed catalytic-cracking technique was applied to the naphtha-reforming process and hydroforming was born. Once again the advent of World War II brought this fixed-bed hydroforming process into prominence for the synthesis of nitration-grade toluene and aviation-gasoline components.

Extensive experimental work on applying the knowledge of the fluid catalytic cracking to the new hydroforming process has been carried out in order to keep pace with the continued increase in octane levels. The result of this work is a new process known as "fluid hydroforming.". The first commercial hydroforming unit to use this new process was put into operation this year at the Destrehan, La. refinery of the Pan-Am Southern Corporation.

The extension of fluid catalyst principles to the more complex Hydroforming Process introduces design problems associated with the more severe operating conditions. This is the subject of this paper.

Cast Iron in the Refinery, by W. J. Buxton, Jun. ASME, Standard Oil Company (Indiana), Whiting, Ind. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-6** (mimeographed).

A DISCUSSION of the use of gray cast iron in a petroleum refinery is presented. Physical properties of cast iron are compared to those of steel. Limitations on the use of cast iron as a result of its structural weakness are given from cost and utility standpoints. Examples are cited of the uses of cast iron which have led to failures. However, the successful use of cast iron in a number of refinery applications is emphasized. Rules currently used at the Whiting Refinery are given for the use of cast-iron valves, pipe, exchanger parts, tower parts, pumps, compressors, and steam turbines.

The use of cast iron in a modern petroleum refinery usually involves a compromise between utility and economy. Cast iron is relatively inexpensive as compared to steel but has very definite use limitations. While this paper discusses the use of cast iron in the refinery, the conclusions to be drawn are necessarily based on local conditions and in some instances may not be applicable to other refinery installations. Cast iron as considered in this paper is the most common type, gray cast iron.

Cast iron was one of the first materials to be used for refinery equipment, and the Whiting Refinery, dating back to 1890, has in the past used cast iron rather generally. In the early history of refineries, pumps, piping, valves, heat exchangers, and even low-pressure vessels were frequently made of cast iron. Its use continued until refining processes

were adopted which required stronger materials, and until the art of steel fabrication had improved to the point where the price differential between cast iron and steel was reduced. The increased material-strength requirements were associated with the use of higher operating temperatures and pressures, the use of relatively long spans for overhead piping, the use of relatively long piping runs which caused expansion and contraction forces detrimental to cast-iron equipment, and the use of quick shutoff devices which caused hydraulic shock. The first steel used in refinery equipment was for pipe, pressure vessels, and tanks. Currently, cast iron is still frequently utilized for valves, fittings, pipe, pumps, exchanger channels, compressors, special atmospheric pressure, and moderate-temperature containers such as grease mixers, and other miscellaneous uses where service conditions are not extreme.

The Application of Roller Bearings in Oil-Field Equipment, by S. M. Weckstein, Mem. ASME, The Timken Roller Bearing Company, Canton, Ohio. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-4** (mimeographed).

ANTIFRICTION bearings may be separated into two major classifications: Ball bearings and roller bearings. Roller bearings may in turn be subdivided into major types as follows: Straight solid rollers, helical-wound flexible rollers, hourglass or concave-shaped rollers, barrel-shaped rollers, needle rollers, and tapered rollers. This paper illustrates these various types and discusses their major characteristics.

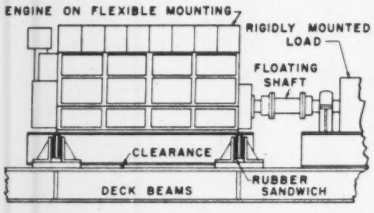
The Pipe-Line Welding Standard, by A. G. Barkow, Texas Illinois Natural Gas Pipeline Company, Chicago, Ill. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-10** (mimeographed).

ACCORDING to this paper, welding can be organized on a basic standard in which there will be few, if any, differentials between the required welding technique prescribed in construction of the various lines to be put into operation. Therefore line welders can be trained and become highly specialized in the one acceptable method to produce the best possible welds under all circumstances. This should add greatly to improvement in quality, reduction in loss due to defective welding, and in reduction of delays.

Since this standard was developed through the efforts of engineers and specialists representing all branches interested in pipe-line construction and operation, its application will assure a uniform inspection standard, both visual and radiographic, which will add to the final safety of the pipe line. Such a standard will also receive full consideration by State and Federal regulatory bodies for inclusion in construction codes.

Practical Approach to Vibration Problems on Drilling Barges, by T. B. Herndon, The National Supply Company, Houston, Texas, and A. B. Reese, Jr., The National Supply Company, Fort Worth, Texas. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-13** (mimeographed).

PROBLEMS with personnel and equipment due to annoying and destructive vibrations on drilling barges in the Gulf Coast area have become increasingly acute in the past several years. The scarcity of experienced personnel, together with the use of costly drilling rigs with involved communication and accessory equipment, has made it imperative that operators give this matter high priority in the design of new barges and in the improvement of those already at work. As machinery manufacturers, the authors' company has had the opportunity of working with several



DRILLING ENGINE ON RUBBER MOUNTING

operators and manufacturers to a successful solution of these mutual problems by means of vibration isolators.

The paper points out that isolation can be accomplished with excellent results and at comparatively small expense. In view of the fact that the first mounts have now been operating well in excess of one year under the normal drilling-rig conditions, more than a sufficient economic life has already been achieved. Light metal covers and other treatments were put into effect to minimize the usually oily condition which exists around the drilling rig, and under similar circumstances in other industries where these rubber mounts are loaded to approximately the same degree they will operate from five to ten years without replacement. The cost of the original installation should be somewhat less than $1200 per large engine and the cost of replacement should be in the neighborhood of $300 to $400. On this basis, if they give the kind of satisfaction already indicated for a period of two years, much has been accomplished.

This work, it is concluded, should be carried on and extended into a more complete treatment of the vibration problem, particularly from the noise standpoint. There are now in use drilling-barge structures relatively free of vibration and at least equipped with certain rest and relaxation areas where noise is held to less than an acceptable minimum.

Salient Mechanical Features of Houdriflow, by R. M. Shirk and D. B. Ardern, Houdry Process Corporation, Philadelphia, Pa. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-11** (mimeographed).

THE history of the development of catalytic cracking in the petroleum industry is packed with examples of the achievements obtained through effective co-ordination of both process and mechanical development. As new processing principles and concepts have evolved, new mechanical designs have been required and many very interesting mechanical problems have been encountered and solved.

Catalytic cracking is, broadly, the process of contacting gas-oil fractions of crude oil with active catalyst under suitable conditions so that 50 to 60 per cent of the gas-oil charge is converted into gasoline in a single-pass operation. As the cracking reactions take place, a carbonaceous deposit is left upon the catalyst, which greatly decreases its activity. However, the coke deposit can be removed by combustion and the catalyst activity is thereby restored so that the catalyst may be used again in the cracking operation.

The Houdry Process Corporation catalytic-cracking processes use catalysts which are in the form of solid cylindrical or spherical pellets approximately $^1/_8$ in. in diam. The use of such catalysts in a moving-bed system was first applied to the Houdry catalytic-cracking process on a commercial scale in 1943. Houdry now licenses a more advanced embodiment of the moving-bed system known as Houdriflow catalytic cracking. Some of the related process and mechanical problems encountered in the development of moving-bed units, and the mechanical features embodied in the solution of these problems in present Houdriflow designs, are discussed in this paper.

Formation of Martensite on Rotary Drilling Lines, by C. M. Zerr, Union Wire Rope Corporation, Kansas City, Mo. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-8** (mimeographed).

THE successful drilling of an oil well today is dependent upon the efficient and intelligent use of a number of highly developed and integrated machines. Included with these machines is the wire rope which is referred to as a rotary line. Like all operating machines, the rotary line is subject to operating conditions which cause wear, fatigue, crushing, and wickering. In practically all cases the driller can readily determine from observation the imminent cause of the wear, fatigue, and crushing. The wickering, on the other hand, is found in places which do not seem to follow any set pattern. Many times these wickers appear at the most inopportune times and places, creating a condition which requires several hundred feet of rope to be cut off. This practice is expensive.

The phenomenon of wickered wires in rotary drilling lines has been a source of much concern and study.

Some wickering readily can be accounted for by the design of equipment and operational problems. Other wickering is caused by changes which take place in the physical structure of the wire.

This paper deals with the wickering caused by the structural change in the wires showing the normal Fe-C equilibrium to be changed to a new equilibrium known as martensite.

High-Pressure Nitriding and Its Applications to the Petroleum Industry, by R. L. Chenault and G. E. Mohnkern, U. S. Steel Corporation, Oil City, Pa. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-3** (mimeographed).

THIS paper describes procedures for case-hardening certain types of alloy steels by nitriding by exposure to the action of ammonia gas at pressures much higher than utilized in the past for this purpose. A pressure range of 200 to 800 psi is recommended for most purposes. The high-pressure process results in a high-quality case of extreme hardness and greatly simplifies control problems. Special furnaces and control equipment are not required and ammonia consumption is reduced by about 95 per cent. Comparisons with conventional nitriding methods show advantages in favor of the pressure method from the standpoints of rate of hard-case formation, maximum hardness obtained, and quality of surface.

Numerous applications of the pressure method of nitriding to the petroleum industry are evident. The combined effects of extreme hardness and wear resistance, along with elimination of notch sensitivity and corrosive action resulting from electrolysis—where dissimilar metals would be required with other materials and treatments—results in a wide variety of possible applications with beneficial results. Some possible applications are pins, bushings, and nozzles for rock bits; barrels, rods, and liners for slush pumps and other types of surface pumps; tool joints, packer parts, china, flow valves, or chokes; plungers, barrels, valves, cages, etc., for subsurface pumps; engine cylinder liners, and the wearing parts of many other types of the great variety of machinery used in connection with petroleum production, transportation, refining, and marketing.

Power Transmission on Rotary Rigs by Friction, Fluid, and Electromagnetism, by M. L. Rizzone, Jun. ASME, United States Steel Corporation, Dallas, Texas. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-9** (mimeographed).

THE transition from steam power to internal-combustion-engine power on rotary drilling rigs has required considerable development work in the design of the power-train elements. The friction clutch has made internal-combustion engines practical but the use of fluid and electromagnetic drives has assisted materially in improving the characteristics of the power flow. As a result, better and fuller utilization of the installed power, smoother operation, and longer wear life of the component parts of the transmission system have been accomplished. An analysis of which type of drive to use, as well as the advantages of each, requires a study of the characteristics of power flow in a drilling rig using internal-combustion engines.

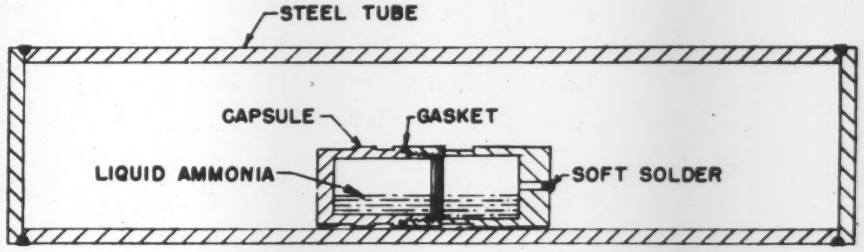
A substantial period of time has elapsed since steam was the prime source of power in the drilling industry. Presently, steam has been almost entirely supplanted by the modern internal-combustion engine and many changes and improvements have taken place in the design concept of the drilling rig, particularly in the various elements which make up the power train from the prime mover to the drill string.

An analysis of all the improvements in the drilling rig would be too broad for any one study. This paper discusses the influence of the friction clutch, the fluid coupling, the torque converter, and the eddy-current coupling in the transmission of power in the modern rig.

Effect of High-Strength Casing and Casing Joints on Design of Casing Strings, by Sheldon H. Reynolds, U. S. Steel Corporation, Houston, Texas. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-16** (mimeographed).

THE development of 110,000 psi minimum yield-strength steel casing and highly efficient threaded connections at costs competitive to the strongest available under present industry specifications allows strings of casing to be designed with reasonable safety factors to greater depths. At intermediate depths they provide for increased inside clearances, or for higher resistance to internal pressures, and decreased over-all string weights.

This paper presents some of the design properties of the new steel casing and



PRESSURE NITRIDING OF INNER SURFACE OF STEEL TUBE; LIQUID AMMONIA, CAPSULE IN PLACE

describes the new threaded connection applied to nonupset casing to provide for high joint strength. Sample casing combinations are used to illustrate the applications of the new developments.

The Triangulation Method for Determining Collapse-Change Points in Casing Design, by R. L. Kastor, Jun. ASME, Shell Oil Company, New Orleans, La. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-15** (mimeographed).

A METHOD for expeditiously and economically determining collapse-change points in a manner adaptable to conventional calculation methods is presented. The method is a graphical solution obtained by constructing a triangle defined by the pressure and tensile loading unique to each particular section in the casing design. Experience indicates that considerable reduction in the amount of time required to design casing strings is possible.

The triangulation method is a graphical solution to the problem. The basic tools required are a chart of curves of the variation of collapse resistance with tensile load, such as are available in almost any casing manufacturer's engineering data book. Briefly, the problem resolves to determining the intersection of two curves, one of which varies linearly while the other approximates a portion of an ellipse. The linear curve relates the variation of hydrostatic pressure with hanging load, while the elliptical curve relates the variation of collapse resistance with hanging load. The technique is based upon the fact that both of the curves vary with the same physical parameters—pressure and weight. By plotting a linear curve of the variation of hydrostatic pressure with hanging load on the same chart with the curves of the variation of collapse resistance with tensile load, the collapse-change points may be determined from the intersection of the two curves. The problem is to determine the intercept and slope of this linear curve.

Automatic Self-Sealing Gate Valves—An Analysis of Valve-Sealing Methods, by A. F. Rhodes, Jun. ASME, McEvoy Company, Houston, Texas. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-12** (mimeographed).

HIGH-PRESSURE steel valves used in the petroleum industry are discussed. The paper traces the development of these valves and analyzes the four methods of valve sealing employed by all such valves. A detailed consideration is given to the automatic self-sealing gate valve. The theory, development, design, and performance of this valve are examined.

The engineering features of the valve-sealing system are as follows:

1 *Seat and Gate Construction.* Each valve contains two complete and independent sealing systems which seal tightly in either direction. Two free-floating and nonwedging gates are in continuous wiping contact with the seats in either open or closed position. This prevents gate leaks due to distortion under pressure and temperature.

A sealing groove is machined on the face of each seat encircling the conduit and is connected to the sealing-compound reservoir by a crossover in the gate. Movement of the gate from the closed position cuts off the sealing groove from the reservoir, which prevents washing downstream of the sealing compound.

A second sealing groove is placed in each seat to seal off leaks between the pressed-in seat and the valve body. This groove is connected directly to the reservoir.

2 *Operating Feature.* The nonwedging, floating-gate arrangement results in maximum ease of operation. A "cheater" or gear operator should never be necessary on this type of valve.

The enclosed reservoirs, which are disconnected from the sealing system except when the valve is closed, result in a large number of operations, before refilling with sealing compound is required. Field experience indicates that 40 to 80 operations are necessary to exhaust the valve, depending on the fluid and velocity of flow.

This also results in a small annual consumption of expensive valve-sealing compound and reduces the cost of valve servicing. In most fields, semi-annual servicing gives satisfactory performance.

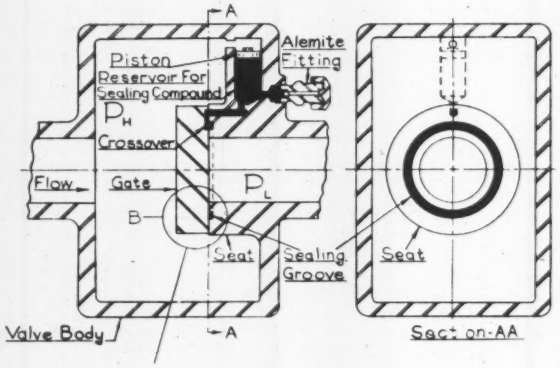
Some Test Data and Conclusions on Casing-Hanger-Slip Capacity, by E. F. Cooke, Jr., Beaumont Iron Works Company, Beaumont, Texas. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-7** (mimeographed).

THIS paper covers data collected from shop tests on supportable load with various lengths of casing slips, the correlation of the data, and the development of usable curves and equations to give safe loads that can be carried by various lengths of slips in relation to pipe wall thickness and tensile strength. The conclusions are limited to one size of casing and thin casing slips.

Prior to 1930 the majority of casing suspensions in oil wells was with threaded connections, slips being used mainly in tubing suspension heads or on shallow strings of casing. The average well depth was about 5000 ft with few deep wells. Through the years between 1930 and 1940, producing sands were found at increasing depths. To meet these increased depths, higher tensile pipe was developed, new technqiues in drilling tested and adopted, and higher pressures were encountered.

During this evolution in the oil industry, the casing slip came into being as a modern tool, which greatly increased the flexibility of casing-setting technique. However, due to the unknowns in the use of this equipment, most manufacturers supplied equipment with casing-supporting slips to the full extent of the limitations allowed by companion equipment or methods of completion.

Today the average well depth is around 8000 ft with the deep wells being beyond 14,000 ft. These long strings of casing are being landed and supported on



SCHEMATIC VIEW OF AN AUTOMATIC SELF-SEALING GATE VALVE

practically the same equipment used in the 30's. This is because the same limitations in equipment exist. These limitations are, of course, the diameter of the blowout-preventer equipment in use, the diameter of the sealing ring used in the connecting flanges, the bore of the slip-supporting body, and the diameter of the casing being used. The use of heavier-wall and higher-strength casing is the principal reason slips are being used successfully today.

Pipe-Line Applications of the Gulf Product Interface and BS&W Recorder, by H. J. EnDean, Mem. ASME, and R. M. Howard, Gulf Research and Development Company, Pittsburgh, Pa. 1953 ASME Petroleum Mechanical Engineering Conference paper No. **53—PET-14** (mimeographed).

IN crude-oil pipe lines, the primary problems are controlling and accurately measuring the contamination of the crude oil. With the increasing diameter of lines and their common-carrier status, accurate, continuous recording of contamination can be of considerable economic significance. In one instance, where manual sampling for contamination control was on a periodic basis, experimental continuous recording disclosed the receipt of crude oil between sampling periods in which the BS content reached a maximum of 11 per cent.

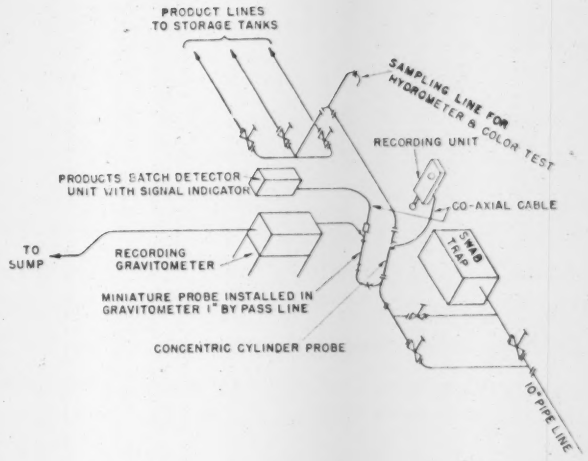
The Gulf-developed instrument as described in this paper is adaptable to both product and crude-oil pipe-line applications for the problems outlined.

The principle of operation of the instrument is based on the measurement of the dielectric constant of a substance and the dielectric change due either to a change of the substance or its contamination by another material.

The dielectric constant "K," or specific inductive capacity of a substance, is defined as the ratio of the capacitance of a capacitor with the substance as the dielectric to the capacitance of the capacitor with air as the dielectric.

The dielectric constant of air by definition is 1 and the values of water and crude oils under the conditions of testing are approximately 80 and 2, respectively. A capacitance-sensitive recorder for detection of contamination of crude oils by water has a dielectric ratio of approximately 40:1 for measurement purposes.

The range of pipe-line products under the condition of test is from a dielectric constant of 1.960 to 2.263, so that an instrument for detecting between products must record accurately for a dielectric constant range of 0.303, with a sensitivity of 0.001.


PRODUCT LINES TO STORAGE TANKS
SAMPLING LINE FOR HYDROMETER & COLOR TEST
RECORDING UNIT
PRODUCTS BATCH DETECTOR UNIT WITH SIGNAL INDICATOR
CO-AXIAL CABLE
TO SUMP
RECORDING GRAVITOMETER
SWAB TRAP
MINIATURE PROBE INSTALLED IN GRAVITOMETER 1" BY PASS LINE
CONCENTRIC CYLINDER PROBE
10" PIPE LINE

SCHEMATIC DIAGRAM OF INSTRUMENT ARRANGEMENT AS INSTALLED AT PRODUCT PIPE-LINE TERMINAL

In the GR&DC capacitance-sensitive instrument, any change in dielectric constant of a stream as it flows through a special capacitor incorporated in a flow line is translated into terms of capacitance actuating an electrical mechanical instrument that records changes in flow-line substance or its contamination.

ASME Transactions for October, 1953

THE October, 1953, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Design of Shrink Fits, by P. R. Paslay and R. Plunkett.

An Investigation of Cemented Tungsten Carbide as Bearing Material, by J. S. Kozacka, H. A. Erickson, H. W. Highriter, and A. F. Gabriel. (52—A-45)

Some Vibration Effects on Surfaces Produced by Turret Lathes, by P. T. Eisele and R. F. Griffin. (53—S-12)

The Effects of Cold-Drawing, Microstructure, and Thermal Treatments on the Machinability and Mechanical Properties of Carbon and Alloy Steel, by F. E. Dieves. (53—S-8)

Temperature and Gas-Analysis Surveys in the Combustion Zone of a Gas-Fired Gas-Turbine Combustor, by K. L. Rieke. (52—A-97)

Aerodynamic Design of Efficient Two-Dimensional Channels, by J. D. Stanitz. (52—A-110)

Cavitation Tests on Hydrofoils in Cascade, by Fukusaburo Numachi. (52—A-87)

Calculation of Transpiration-Cooled Gas-Turbine Blades, by J. N. B. Livingood and E. R. G. Eckert. (53—S-37)

The Mechanism of Disintegration of Liquid Sheets, by J. L. York, H. E. Stubbs, and M. R. Tek. (53—S-40)

New Aspects of Natural-Convection Heat Transfer, by Simon Ostrach. (53—S-43)

Local Heat-Transfer Coefficients on Surface of an Elliptical Cylinder, Axis Ratio 1:3, in a High-Speed Air Stream, by R. M. Drake, Jr., R. A. Seban, D. L. Doughty, and S. Levy. (52—A-59)

Combustion of a Low-Volatility Fuel in a Turbojet Combustion Chamber—Effects of Fuel Vaporization, by V. V. Holmes, A. J. Pahnke, O. A. Uyehara, and P. S. Myers. (52—A-50)

Investigation of Flame Temperatures in a Single-Cylinder Spark-Ignition Engine, by J. H. Potter and R. B. Dillaway. (53—S-46)

On the Evaluation of the Accuracy of the Coefficient of Discharge in the Basic Flow-Measurement Equation, by A. L. Jorissen. (52—A-144)

Some Notes on Dust-Sampling Equipment and Technique, by W. C. Holton and E. J. Schulz.

An Investigation of the Burning Characteristics of Pulverized Cinders, by J. M. Allen. (53—S-2)

Oil Whip of Flexible Rotors, by A. C. Hagg and P. C. Warner. (52—A-162)

European Practice With Sulzer Monotube Steam Generators, by Jacques Gastpar. (52—A-121)

Investigation of Gravity Reinjection of Fly Ash in a Spreader-Stoker-Fired Boiler Unit, by C. H. Morrow, W. C. Holton, and H. L. Wagner.

Approaching the Control Problem of the Automatic Chemical or Petroleum Plant, by M. V. Long and E. G. Holzmann. (52—A-166)

An Analysis of the Dynamics of Hydraulic Servomotors Under Inertia Loads and the Application to Design, by Harold Gold, E. W. Otto, and V. L. Ransom. (53—S-1)

Dynamic Operation of a Force-Compensated Hydraulic Throttling Valve, by J. L. Bower and F. B. Tuteur. (53—S-25)

ASME 1953 FALL MEETING PREPRINTS

Pamphlet copies of the following ASME Fall Meeting papers are available from ASME Order Department, 29 West 39th Street, New York 18, N. Y. *See page 911 for details*

Paper No.	*Title and Author*
53—F-1	Properties of Residual Petroleum Fuels, by W. Sacks
53—F-2	Erosion by Melting and Evaporation, by Kurt Berman
53—F-3	Rapid Measurements of Thermal Diffusivity, by G. E. McIntosh, D. C. Hamilton, and W. L. Sibbitt
53—F-4	A Stable Numerical Solution for Transient Heat Flow, by George Leppert
53—F-5	Static Flow Characteristics of Single and Two-Stage Spring-Loaded Gas Pressure Regulators, by A. S. Iberall
53—F-6	Calculation of Transient Temperatures in Pipes and Heat Exchangers by Numerical Methods, by G. M. Dusinberre
53—F-7	The Study of Transients in Linear Feedback Systems by Conformal Mapping and the Root-Locus Method, by V. C. M. Yeh
53—F-8	Thermal Lags in Flowing Systems Containing Heat Capacitors, by J. W. Rizika
53—F-9	Design Considerations in Kodak Park's Power System, by H. A. Decker
53—F-10	An Analytical Approach to the Design of Quadric Chain Mechanisms, by Ferdinand Freudenstein
53—F-11	An Illustration of Automatic Assembly, by C. E. Kraus
53—F-12	Some Problems in the Design of a Differential-Pressure Transmitter, by J. R. Davidson
53—F-13	Minimization of Gear-Train Inertia, by E. G. Burgess, Jr.
53—F-14	Manufacture and Application of Tooth-Spaced Couplings and Clutches, by Ernest Wildhaber
53—F-15	Machine Design and Problems—Before and After, by H. H. Langdon
53—F-16	Standard Data Problems and Solutions, by Gerald Nadler
53—F-17	Installation of Fuel-Gas Piping on Premises of Industrial Consumers, by E. L. Spanagel
53—F-18	Lighting-Off and Starting-Up Precautions for Stoker-Fired Boilers, by H. W. Andrews
53—F-19	Cyclic Catalytic Reforming of Natural Gas, by G. L. Calderwood
53—F-20	Combustion Efficiency Versus Cycle Length of Domestic Oil Burners, by J. R. Akerman, E. A. Farber, and G. L. Larson
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53—F-22	Design and Operation of High-Recovery Regenerative-Type Air Preheaters, by George Braddon and Joseph Waitkus
53—F-23	The Solution of Pipe-Expansion Problems by Punched-Card Machines, by L. H. Johnson
53—F-24	Activity Sampling and Analysis—Present State of the Theory and Practice, by H. O. Davidson
53—F-25	The Theory and Practice of Standard Data, by Adam Abruzzi
53—F-26	Profits Through Effective Machine-Replacement Programs, by C. M. Beach
53—F-27	Barrel Finishing—Applications in Metal-Manufacturing Industry With Job-Shop Conditions, by J. G. Reed
53—F-28	Coal-Handling Facilities for Milliken Station With Automatic Remote-Control Features, by H. C. Schweikart
53—F-29	Measurement of Superimposed Surface Finishes, by R. E. Carroll and N. Gortz
53—F-30	Development of a Test for Broaching Titanium and Its Alloys, by R. E. McKee and W. W. Gilbert
53—F-31	Russell Station Reheat Unit Design and Operating Experience, by I. G. McChesney

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53—PET-3	High-Pressure Nitriding and Its Applications to the Petroleum Industry, by R. L. Chenault and G. E. Mohnkern
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53—PET-10	The Pipe-Line Welding Standard, by A. G. Barkow
53—PET-11	Salient Mechanical Features of Houdriflow, by R. M. Shirk and D. B. Ardern

Paper No.	Title and Author
53—PET-12	Automatic Self-Sealing Gate Valves, by A. F. RHODES
53—PET-13	Practical Approach to Vibration Problems on Drilling Barges, by T. B. HERNDON and A. B. REESE, JR.
53—PET-14	Pipe-Line Applications of the Gulf Product Interface and BS&W Recorder, by H. J. EN DEAN and R. M. HOWARD
53—PET-15	The Triangulation Method for Determining Collapse Change Points in Casing Design, by R. L. KASTOR
53—PET-16	The Effect of High-Strength Casing and Casing Joints on the Design of Casing Strings, by Sheldon H. REYNOLDS

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Paper No.	Title and Author
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53—IRD-2	Processing and Proportioning Materials by Weight, by ENRICO KLEIN
53—IRD-3	Characteristics of Components in Pneumatic Weighing Systems, by J. W. MILROY and G. C. MAYER
53—IRD-4	Remote Weight Measurement by Means of Hydraulic Load Cells With Electrical Transmitters, by J. J. HICKS
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53—IRD-10	High-Speed Weighing, by N. G. MALONEY
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53—IRD-12	Electric Strain Cell Weighing, by LEE BARNETTE
53—IRD-13	Electric Weighing in Steel-Mill Processes, by R. J. CARLETON, JR.
53—IRD-14	Solids Flow and Level Measurement by Continuous Weighing, by R. H. BERG

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Additional coupon books, each containing ten coupons, are available to members at $2 each; to nonmembers at $4 each.

For further details, see page 911.

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Slavery and the Engineer

To the Editor:

Religious and political leaders have for centuries endeavored to eliminate human slavery. By human slavery I mean the actual ownership as property of a human being by another human being or group. This property right thus conferred was absolute, sometimes including the power to inflict death.

In spite of all these efforts, slavery persisted until the "coming of age" of the engineer and then ceased only in those civilized societies where the effects of the engineer's work could be realized. What is the connection, if any, therefore, between the engineer and the abolition of human slavery?

Slavery existed, as does everything else that persisted for any great period, simply because there was a need for it. How could there be a need for anything so awful as slavery?

In primitive machineless social orders, the struggle for food, clothing, and shelter was so great that it required substantially the entire time and effort of each individual. For security against natural and human enemies, however, man soon found it advisable to separate out a group of nonproducers to include soldiers, rulers, and religious and political leaders. To maintain this group of non-producers at the same or even better standard of living another group was required, which group would have a very low standard of living. This group comprised slaves usually caught by soldiers or police or sometimes even volunteers, who wished thereby to have some sort of security against death.

The higher the degree of civilization in such a society, the more nonproducers are required, with resultant tremendous increase in the number of slaves. The statistics of the number of slaves, their brief average life, and the cruelties of servitude, even in Christian nations, are almost incredible today. Actual slavery or modified forms of slavery, such as indentured servants, peonage, or convicted felons at the galley sweeps, existed in all so-called civilized countries until well into the nineteenth century. The engineer, the high priest of the relatively young Industrial Revolution, then began to make its effects felt in the Western World, with a constantly decreasing need for human slaves. The competition of slave and free worlds often resulted in warfare, with victory sometimes to the free, as witness our War of 1861–1865.

Against the need for slaves, well-directed efforts of law and order were almost powerless. But once the product of the engineer became widespread slavery disappeared. To quote the well-known phrase, "machines, which are iron slaves, replaced human slaves," thereby destroying the need for slavery. Keeping the slave became too expensive in comparison with the machine, so the laws against slavery became enforceable.

Having destroyed the need for slavery in a large portion of the world, the engineer is now providing the means to protect the free world from attacks by a slave world which has not yet distributed the effects of engineering throughout its population and therefore feels a need for slavery.

The engineer cannot claim to have been the one who alone abolished slavery in highly developed civilizations, but he can rightly claim to be the one who abolished the *need* for slavery. Should he not, therefore, assert this claim?

What could be a better opportunity than the 75th Anniversary of the ASME? Why not make this greatest achievement of the engineer the theme of the celebration in 1955?

About this theme it can be shown that because of mechanical invention and the work of the engineer, the need for human slavery has disappeared and substantially all ranks of society have obtained sufficient leisure to progress together. Simultaneously, the engineer has provided the means whereby so-called culture has been diffused throughout the population so that developments in knowledge, social custom, physical, mental, and spiritual enjoyment are enjoyed in large degree not only by the wealthiest or most powerful ranks of society, but also by the poorer. This situation never existed before. This applies, of course, only to the countries where the work of the engineer has been effective.

In accomplishing this work the engineer has given man the means to overcome the obstacles of space, time, and effort, and amongst the many devices or methods he has introduced may be mentioned mass production, interchangeable manufacture, new products, new methods of processing old products, steam, electric, petroleum, and coal-powered engines, and a multitude of other means.

Again, without organization man can accomplish little; with too much he accomplishes nothing! Too much organization makes for statism; too little, for anarchy! The study of the proper amount of organization in human industry is the subject of a special branch of the engineering profession covered by the ASME Management Division.

(Then we can proceed to show the aims of each of the other divisions or groups of divisions of the ASME.)

The work of the engineer may be summarized by saying that he has provided the physical foundation on which human liberty may be built by himself and others and his mechanical advances have made this liberty further extended to all, and protects against those who might wish to kill it and to enslave. Then may our slogan be:

"More Freedom to More People Because of Engineering," or

"Freedom Ever Increasing Through Engineering."

Crosby Field.[1]

Heat-Transfer Systems For Nuclear Power Plants

Comment by Philip A. Salmon[2]

While the optimum steam conditions for nuclear power plants have not yet been proved, it seems likely that the steam pressure will be considerably greater than that of the liquid-metal heat carrier.[3] It also seems desirable, in the interest of minimizing capital investment, to avoid double-tube heat-exchange surface with a guard, or detection fluid, between tubes. These thoughts, which were provoked by this excellent paper, lead to the observation that the land-

[1] Brooklyn, N. Y. Fellow ASME. 1953 ASME Medalist.

[2] Senior Engineer, Public Service Electric and Gas Company, Newark, N. J.

[3] "Liquid Metal Heat-Transfer System for Nuclear Power Plants," by Thomas Trocki and D. B. Nelson, Mechanical Engineering, vol. 75, June, 1953, pp. 474–476.

based nuclear power plant will need some sort of pressure-relieving system which will make it unnecessary to design such a nonradioactive liquid-metal system to withstand design conditions of the steam system.

AUTHORS' CLOSURE

Mr. Salmon's point on the possibility of simplification of the secondary circuit is well made. The system described in the paper was conceived several years prior to the paper and subsequent work indicates that a pressure-relieving system for the secondary circuit appears feasible.

Protection of the secondary circuit with a pressure-relieving system permits the following:

a Low design pressure.
b Possible use of single-wall tubes in steam generator.
c Low-pressure intermediate heat exchanger.

These represent potential cost reductions which may be realized from the use of a relief system. In this case, relief must be provided for steam pressure plus any additional energy resulting from a liquid metal-water reaction. The usual relief devices have been used successfully in small experimental systems, but no experience is available with large-scale relief systems. The plant described incorporated blow-out disks on the sump tanks on both primary and secondary systems plus a combination blow-out disk and relief valve on both surge tanks. However, no casualty activating these devices has occurred.

THOMAS TROCKI.[4]
D. B. NELSON.[5]

[4] Head, Heat Transfer Systems Unit, Engineering and Production Section, Knolls Atomic Power Laboratory, Schenectady, N. Y. Jun. ASME.
[5] Power Plant Unit, Engineering and Production Section. Jun. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Writings of the Gilbreths

THE WRITINGS OF THE GILBRETHS. Edited by William R. Spriegel and Clark E. Myers, with a foreword by Lillian M. Gilbreth. Richard D. Irwin, Inc., Homewood, Ill., 1953. Cloth, 5¾ × 9 in., figs., charts, index, xi and 513 pp., $7.35.

REVIEWED BY J. M. JURAN[1]

THIS book closes an important gap in engineering literature. The writings of the Gilbreths, variously published in nine books between 1907 and 1917, have been out of print for years. Now they are again available, and in one volume.

Naturally, a republication from books 40 and 50-years old is warranted only if the books were, in the first instance, fundamental in character. But a restudy of these writings has a sobering effect on the reader. It is not only that the Gilbreths had so considerably anticipated modern industrial practice; even more significant is the fact that modern industrial practice has not yet caught up with much that the Gilbreths expounded so clearly, decades ago.

"Field System," "Concrete System," and "Bricklaying System" recall the mastery of Frank Gilbreth, not merely in the mechanical elements of building construction, but in the elements of organization and management for building construction. In particular, the sense of fair play in human relations is seen to underlie all actions.

"Primer of Scientific Management" poses questions which have lost none of their pertinence during the past 40 years. It also provides answers equally refreshing and pertinent. Some of the answers might well surprise today's readers. For example, on p. 99, "The best indicator of the quality of the management is . . . . . the amount that the wages are higher and the amount that the costs of production are lower than usual" (for that kind of work in other establishments).

In the books on motion study "Motion Study," "Applied Motion Study," "Motion Study for the Handicapped," and "Fatigue Study," there pass in review the numerous tools evolved by the Gilbreths for analyzing the nature of human work. The widespread use of these tools has greatly reduced human drudgery over the entire globe. This work of the Gilbreths, in the elegant words of the free Czech Zimmler, was a fruit which "sweetened the work of every laborer."

Finally there is "The Psychology of Management," which goes far to blueprint what parades today under the names of "personnel relations," "communication," and the like. We have not fully utilized this blueprint.

The editors have in the main preserved completeness and continuity. It must have been a hard decision to do without the numerous illustrations and photographs which characterized some of the books. Likewise, the drastic shortening of "Motion Study for the Handicapped" will not appeal to those who are conscious of the pioneering work done by the Gilbreths for paraplegics following World War I.

With these limitations, which are regarded by this reviewer as minor, great credit is due to Dean Spriegel, Professor Myers, and the publishers for putting these writings back into print.

[1] Consulting Management Engineer, Tuckahoe, N. Y. Mem. ASME.

Books Received in Library

ASTM MANUAL ON MEASUREMENT AND SAMPLING OF PETROLEUM AND PETROLEUM PRODUCTS. American Society for Testing Materials, Philadelphia, Pa., 1953. 133 p., 9 × 6 in., paper. $1.50. This compilation, presenting the standard practices most widely used today, provides detailed methods for measuring and computing oil in storage tanks of various types and for getting typical samples. Each section—gaging, temperature measurement, volume calculations, water and sediment, gravity, sampling—includes instructions, precautions, and essential data.

ADVANCES IN APPLIED MECHANICS, Volume III. Edited by Richard von Mises and Theodore von Kármán. Academic Press Inc., New York, N. Y., 1953. 324 p., 9¼ × 6¼ in., bound. $9. Eight papers by specialists, are presented dealing with important subjects of present-day research: boundary-layer problems in applied mechanics; aerodynamics of blasts; shocks in mixed subsonic-supersonic flow patterns; vortex systems in wakes; theory of the ideal plastic body; methods of analysis of nonautonomous systems; and two papers on fluid flow.

ANNIVERSARY VOLUME ON APPLIED MECHANICS. Dedicated to C. B. Biezeno. De Technische Uitgeverij H. Stam, Haarlem, Netherlands, 1953. 328 p., 9¾ × 6½ in., bound. 20 Fl. The 19 papers contributed to this volume cover a wide range of topics from pure mathematics to structural design, including stress analysis, combustion theory, vibration, pressure-measuring devices, and a variety of problems in the field of applied mechanics. The book also contains a brief biography and a bibliography of the writings of this Dutch mechanical engineer who organized the first International Congress for Applied Mechanics.

ANNUAL REPORT ON THE PROGRESS OF RUBBER TECHNOLOGY. Volume XVI, 1952. Edited by T. J. Drakeley. W. Heffer & Sons, Ltd., Cambridge, England, for the Institution of the Rubber Industry, London, England. 165 p., 9¾ × 6½ in., bound. 21s. The separate chapters in this survey of recent developments deal with the production of raw rubber, the properties of latex, the physics and chemistry of raw rubber, testing and specifications, compounding ingredients, fibers and fabrics, processing machinery, and a wide range of rubber products such as tires, hose and tubing, footwear, mechanical rubber goods, cellular rubber, etc. References to the current literature are given.

AUFGABENSAMMLUNG ZUR THERMODYNAMIK DES WARME- UND STOFFAUSTAUSCHES IN DER VERFAHRENSTECHNIK. By Werner Matz. Verlag, Dr. Dietrich Steinkopff, Darmstadt, 1953. 138 p., 9 × 6⅛ in., paper. DM. 16.00. A collection of problems in thermodynamics involving exchange of heat and of material in process technology. One-hundred practical examples and solutions are given to show applications of thermodynamic theory in such processes as evaporation, distillation, absorption, and extraction. A companion volume to the author's textbook on the same subject published in 1949.

BERECHNUNG DER AUSMAUERUNG STAHLERNER GEFASSE. (Verfahrenstechnik in Einzeldarstellungen, no. 1.) By W. Matz. Springer-Verlag, Berlin, Germany, 1953. 75 p., 9⅛ × 6⅛ in., paper. DM. 10.50. A manual for engineers on stresses and design of acid and alkali-resistant internal and external ceramic-brick linings for steel vessels having steady heat flow through the walls. A second book is planned for cases where the walls are subject to heating and cooling.

DIESEL ENGINE CATALOG, Volume 18, 1953. Edited and published by Rex W. Wadman. Diesel Engines, Inc., Los Angeles, Calif., 1953. 369 p., 13¾ × 10¾ in., bound. $10. A standard guide to the diesel industry brought up-to-date on new designs developed during the past 12 months. Detailed text descriptions of the important engines are illustrated by diagrams and cross-section drawings, and tables of specifications for the diesels of each manufacturer are supplied. The products of the more important auxiliary equipment manufacturers are also described. There is a classified directory of engine and accessory manufacturers.

ELECTRICAL ENGINEERING. By Fred H. Pumphrey. Prentice-Hall, Inc., New York, N. Y., second edition, 1953. 404 p., 9¼ × 6¼ in., bound. $8. This text is intended for students specializing in technical fields other than electrical engineering. The first 12 chapters review the basic theory of electrical circuits, electromagnetism, electrical machinery, and measurements. The last chapters describe typical applications, controls, electrochemical processes, electron tubes, and various specialized applications of importance to civil, mechanical, and electrical engineers.

ENGINEERING DRAWING. By Frank Zozzora. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 369 p., 11¼ × 9 in., bound. $5. A test and reference book for the student or practicing engineer, arranged for easy progress in study, which begins with the basic elements and leads through geometrical constructions to sectioning, auxiliary views, intersections and developments, and various specialized depictions. Carefully chosen illustrations and selected problems amplify and demonstrate the text content.

THE FARMERS TOOLS, 1500–1900. By G. E. Fussel. Andrew Melrose, London, England, 1952. 246 p., 9¼ × 6¼ in., bound. 42s. This history traces the development of farm implements and machinery through the four centuries preceding the advent of the tractor. The mechanical details of these implements and machines—classified by the seasons from seed-time to harvest—are discussed as they have evolved through the centuries, with some reference to economic and social changes at particular times. The book is fully annotated and includes a glossary, chronological list of tools, and a bibliography.

GAS-TURBINE ANALYSIS AND PRACTICE. By Burgess H. Jennings and Willard L. Rogers. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 487 p., 9¼ × 6½ in., bound. $8.50. Written primarily for the undergraduate and graduate student, this text also presents information on gas-turbine fundamentals, performance, and practices on a level suited to any reader with a good engineering background. The book begins with a discussion of fundamentals and then applies these to specific components of the gas-turbine power plant, with consideration being given both to thermodynamic aspects of design and to stresses and materials of construction. Complete air tables and combustion-gas charts are provided.

GLEITLAGER. By E. Schmid and R. Weber. Springer-Verlag, Berlin, Germany, 1953. 394 p., 9¼ × 6½ in., bound. DM. 45.00. A comprehensive monograph covering the materials, theory, design, lubrication, manufacture, and testing of sleeve bearings. Both metallic and nonmetallic bearings are considered. There is a considerable bibliography arranged by chapters.

HANDBOOK OF MATERIAL TRADE NAMES. By O. T. Zimmerman and Irvin Lavine. Industrial Research Service, Dover, N. H., 1953 edition. 704 p., 10½ × 7½ in., bound. $20. This alphabetical list of some 15,000 trade names of commercial materials gives brief information concerning compositions, properties, and uses as well as the name of the manufacturer or distributor. A wide range is covered including metals, plastics, chemicals, pharmaceuticals, etc. Distinguishing symbols indicate registered and unregistered trademarks and common names. A directory section provides addresses of manufactuers, and a new classified section lists materials according to major use or composition.

HANDBUCH DER METALLBEIZEREI. By Otto Vogel. Verlag Chemie, Weinheim, Germany, second edition, 1951. 10¾ × 8 in., bound. Volume 1: Nichteisenmetalle. 410 p., Dm. 49.20 Volume 2: Eisenwerkstoffe. 538 p., Dm. 63. This comprehensive handbook covers nonferrous metals in volume 1 and ferrous materials in volume 2. Each volume is complete in itself with individual author and subject indexes and classified directory to German sources of supply. The volumes are divided into two parts: a general section covering plant and equipment, materials, waste disposal, and hazards; a practical section covering a wide range of pickling and cleaning processes. The new edition has been thoroughly revised.

HARTEREI-TECHNISCHE MITTEILUNGEN. Volume V. Edited by P. Riebensahm. Carl Hanser Verlag, Munich, Germany, 1952. 283 p., 9½ × 6¾ in., bound. DM. 24.00. Twelve previously unpublished papers of a 1949 "hardening" colloquium deal with a wide range of topics of practical interest to steel heat-treaters: kinetics of martensite formation; transformation characteristics; hardness testing; statistical methods as applied to heat-treating; and various surface-hardening processes.

INDEX. (Massachusetts Institute of Technology, Radiation Laboratory Series, No. 28.) Edited by Keith Henney. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 160 p., 9¼ × 6¼ in., bound. $4.50. A complete guide to the 27 monographs of this series, which cover not only the essential features of the work of the laboratory but also present a full account of the technical developments in the field. The index volume also contains an account of the establishment and organization of the Radiation Laboratory.

AN INTRODUCTION TO SCIENTIFIC RESEARCH. By E. Bright Wilson, Jr. McGraw-Hill Book Company, Inc., New York, N. Y., 1952. 375 p., 9¼ × 6¼ in., bound. $6. A book of practical suggestions for planning and carrying out scientific research, intended for students beginning research and for the experienced research worker with little training in methods of investigation. Principles and procedures applicable to a wide range of sciences rather than to a specific science are presented in the order in which they arise in research. Apparatus design and data analysis are given the fullest treatment.

KERNEL FUNCTIONS AND ELLIPTIC DIFFERENTIAL EQUATIONS IN MATHEMATICAL PHYSICS. By Stefan Bergman and M. Schiffer. Academic Press, Inc., New York, N. Y., 1953. 432 p., 9¼ × 6¼ in., bound. $8. The subject of this book is the theory of boundary-value problems in partial differential equations. This theory plays a considerable role in various fields of physics and engineering, as indicated by the chapter headings of Part A: Theory of heat conduction; fluid dynamics; electro- and magnetostatics; elasticity. Although the physical significance is studied, the approach is primarily mathematical and a systematic treatment is followed without simplification.

KESSELBETRIEB. Edited by Vereinigung der Grosskesselbesitzer. Vulkan-Verlag, Dr. W. Classen, Essen, Germany, third edition, 1953. 528 p., 8¼ × 6¼ in., bound. DM. 36.00. This compilation of practical experience provides a systemic textbook covering all aspects of the technical operation of large industrial boilers. There are chapters on fuels, firing, boiler types, component parts, feedwater, and control, and considerable material on methods of overcoming various difficulties, problems, and dangers. Applicable German specifications and materials are listed.

DER LADUNGSWECHSEL DER VERBRENNUNGSKRAFTMASCHINE. Part III: Der Viertakt Ausnützung der Abgasenergie für den Ladungswechsel. (Die Verbrennungskraftmaschine, Volume 4, part 3.) By Hans List. Springer-Verlag, Vienna, Austria, 1952. 175 p., 10¾ × 7½ in., paper. $8.60. Various aspects of

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

scavenging are covered in this publication of which Section A, entitled "the 4-stroke cycle," deals with valve-timing systems, the Burt-MacCollum sleeve valve, and the influence of the intake manifold on charge distribution in multicylinder engines. Section B deals with the utilization of exhaust-gas energy for reaction propulsion, the fundamentals of turbo-supercharging of both 4-cycle and 2-cycle engines, and the Kadenacy effect.

MANUFACTURING AND TESTING OF PAPER AND BOARD. (Pulp and Paper Manufacture, Volume 3.) J. Newell Stephenson, editor. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1953. 945 p., $9^1/_4 \times 6^1/_2$ in., bound. $11. Third of a new series of four books, this volume devotes over 600 pages to detailed descriptions of the construction and operation of the major types of papermaking machines. The remaining third of the book deals with paper finishing, coated papers, handmade papers, and paper testing. The book is a considerably revised version of Vol. 5 of the well-known earlier series on pulp and paper.

MEASUREMENT TECHNIQUES IN MECHANICAL ENGINEERING. By R. J. Sweeney. John Wiley and Sons, Inc., New York, N. Y., 1953. 309 p., $9^1/_4 \times 6^1/_4$ in., bound. $5.50. A practical, compact treatment of the principles and techniques of measurement for the performance testing of power equipment—engines, pumps, compressors, and combustion and heat transfer apparatus. In addition to the descriptions of instrument types and their uses, the book discusses such topics as the factors underlying selection and the function of instruments as signaling devices to automatic controllers.

PROPERTIES OF METALLIC SURFACES. (Monograph and Report Series, No. 13.) Institute of Metals, London, England, 1953. 368 p., $8^3/_4 \times 5^3/_4$ in., bound. $5.50. This monograph contains thirteen papers by outstanding authorities presented at a symposium of the Institute of Metals and covers a wide range: microscopical techniques in metallurgy; influence of machining on surface condition; effect of surface condition on strength and mechanical properties of metals; diffusion coatings; surface-film properties and effects; character of abraded surfaces; etc. Both the papers and the extensive technical discussion are effectively illustrated.

REVIEW OF METAL LITERATURE, Volume 9, 1952. Edited by Marjorie R. Hyslop. American Society for Metals, Cleveland, Ohio, 1953. 977 p., $9^1/_4 \times 6^1/_4$ in., bound. $15. An annotated annual survey of articles and technical papers appearing in several hundred engineering, scientific, and industrial journals and books received in the Library of Battelle Memorial Institute and published in installments in Metals Review through the year. The main arrangement is in classified form, with author and subject indexes. The list of publications abstracted gives addresses.

STAHLDRAHT. By Anton Pomp. Verlag Stahleisen, Düsseldorf, Germany, second edition, 1952. 392 p., $9^1/_4 \times 6^3/_4$ in., bound. DM. 38.00. A comprehensive treatment of the manufacture and properties of steel wire including materials, principles, methods, and equipment, preparation for drawings, heat-treating methods, lubricants, straightening and cutting, polishing, plating, and testing. The extensive bibliography has been brought up to date along with the text material.

SYMPOSIUM ON RECENT DEVELOPMENTS IN THE EVALUATION OF NATURAL RUBBER. (Special Technical Publication No. 136.) American Society for Testing Materials, Philadelphia, Pa., 1953. 111 p., 9 × 6 in., paper. $2.25. The papers presented in this symposium represent an approach to the development of standardization of test methods. They cover dirt determination, viscosity measurements, cure rate, vulcanization characteristics, and various physical characteristics of crude rubber. The preparation of a standard natural rubber is discussed.

TABLE OF ARCTAN x. (Applied Mathematics Series, No. 26.) National Bureau of Standards. Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 1953. 170 p., $10^1/_2 \times 8$ in., bound. $1.75. This is the first contribution to what is intended to be a complete set of tables of the inverse trigonometric and hyperbolic functions, a useful tool in a variety of applications. The tabulation is to 12 decimal places over a range of x from 0 to 10,000 with intervals ranging from .001 to 10.

TABLES FOR ROCKET AND COMET ORBITS. (Applied Mathematics Series, No. 20.) By Samuel Herrick. National Bureau of Standards, available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 1953. 100 p., $10^1/_2 \times 8$ in., bound. $1.75. The anticipated development of rocket navigation has directed serious attention to rectilinear motion in the two-body problem. For rectilinear orbits these tables make it possible to determine position and velocity from the time. They may also be used for the so-called "nearly parabolic" orbits.

TECHNISCHE HARTEMESSUNG. By Herbert von Weingraber. Carl Hanser Verlag, Munich, Germany, 1952. 374 p., $9^3/_4 \times 6^3/_4$ in., bound. DM. 36.00. A comprehensive reference book covering all aspects of hardness testing of metals and nonmetallic materials. Major topics dealt with include the following: concept of hardness in materials technology; methods of testing; testing equipment and accessories; general requirements for obtaining satisfactory results; special fields of application. A bibliography of some 700 references is appended.

TRAFFIC MANAGEMENT IN INDUSTRY. By Leslie A. Bryan. Dryden Press, New York, N. Y., 1953. 452 p., $9^1/_2 \times 6^1/_2$ in., bound. $5.50. The opening chapter serves as a general orientation to industrial traffic management. Succeeding chapters describe the general functions of a traffic department, its organization, personnel, and administration. There are detailed discussions of specific duties in connection with rates, expediting, intraplant transportation, materials handling, etc. Forms and legal aspects also are covered.

VERSCHLEISS, BETRIEBSZAHLEN UND WIRTSCHAFTLICHKEIT VON VERBRENNUNGSKRAFTMASCHINEN. (Die Verbrennungskraftmaschine, Volume 14.) By Carl Englisch. Springer-Verlag, Vienna, Austria, second edition, 1952. 288 p., $10^3/_4 \times 7^1/_2$ in., paper. $12.40. This volume of an extensive series on internal-combustion engines deals with three major topics: general principles of wear in engines, and the wear of engine parts; an analysis of the consumption of fuel, oil, and coolants; and a brief discussion of the principles of engine economy in motor vehicles, stationary and marine engines, tractors and farm engines. Microphotographs, charts, and diagrams are used to full advantage.

ASME BOILER CODE

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

As need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Material Specifications, 1949

EDITORIAL NOTE

The Boiler Code Committee has approved adding to Section II the following new specification:

SA-285-52aT, Specification for Low and Intermediate Tensile Strength Carbon-Steel Plates of Flange and Firebox Qualities (Plates 2 In. and Under in Thickness).

Announcement

Fig. UCS-28.2, Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure—Carbon Steel Specified Yield Strength 31,000 to 40,000 psi (1952 Section VIII), has now been developed and is available for distribution by the Society to all inquirers.

ASME NEWS

With Notes on the Engineering Profession

Record Number of Sessions Scheduled at ASME 1953 Annual Meeting

Statler, McAlpin, and Governor Clinton Hotels, Nov. 29–Dec. 4

THE largest number of sessions ever scheduled for an Annual Meeting of the Society awaits the thousands of mechanical engineers from all over the country expected to attend the 1953 Annual Meeting of The American Society of Mechanical Engineers, Nov. 29–Dec. 4. This year there will be 113 sessions which will spill over into three hotels. Headquarters for the Meeting will be the Statler Hotel in New York, N. Y., with the McAlpin and the Governor Clinton devoted to special sessions.

The record number of technical sessions on the program reflects the increasing areas of engineering knowledge being covered at ASME Annual Meetings. Each year more papers are scheduled and more sessions set up, bearing witness to the increasing interest of mechanical engineers in presenting their ideas before a discerning engineering audience and in having new developments and methods critically inspected and discussed by their fellows.

With over 200 papers scheduled for the Meeting, there will be a wide variety of subject matter for members to chose from. In addition to the large number of technical sessions, there will be special features to attract members and guests at the Meeting. There will be an abundance of symposiums and panels on a variety of subjects. The Henry R. Towne and Roy V. Wright Lectures will be delivered during the Meeting. There will be college reunions and inspection trips to nearby plants for interested guests. Many luncheons and dinners are scheduled at which engineers will have an opportunity of meeting their fellows and enjoying the privilege of listening to addresses by prominent leaders in the Society and the engineering profession.

The technical program was published on pages 836–841 of the October issue of MECHANICAL ENGINEERING. Members are urged to consult the program as a guide in deciding which of the technical sessions, luncheons, and dinners will be of most interest to them. Some of the high lights of the Annual Meeting follow.

IRD Symposium on Frequency Response

One of the most important of these events is the Instruments and Regulators Division Symposium on Frequency Response. This two-day five-session symposium was arranged by the IRD Dynamic Systems Committee in recognition of the increasing importance of the frequency-response field in industry today. The Dynamic Systems Committee was formed to recommend standards for the presentation of frequency-response data. The frequency-response approach to the design of automatic equipment is the one most commonly used today. Frequency response has been used in the servomechanism, aeronautical, and electrical fields for a number of years and is now making an extensive invasion of the process-control field and other areas of industry. Frequency response had its origin in the electrical-engineering field but it has not been neglected by ASME. The first book in the field, by R. C. Oldenbourg and Hans Sartorius, was translated from the German by Prof. H. L. Mason and published by ASME in 1948. Since the publication of the pioneering paper in the 1946 Transactions by Gordon Brown and A. C. Hall, on basic frequency-design methods, nine papers on the subject have been published in the Transactions of ASME.

The IRD Symposium on frequency response will have speakers from the United States and five European countries delivering papers on different aspects of the subject. The 16 papers on the program will cover the range of interests of those new to the field to those who are experts. The Symposium papers will bring out the use of frequency response for checking differential equations, for diagnosing malfunctioning of equipment, and for the synthesis and direct design of automatic controls. Some specific subjects include: Survey of methods of analyzing automatic control systems, results of applying frequency response to actual processes in chemical plants, results of making frequency-response runs on the entire Swedish power system, methods of obtaining transient response from frequency response, and theory of linear systems. Featured on the IRD Symposium are two luncheon talks on early efforts in the field. One is by Harry Nyquist of the Bell Laboratories, on "My 1932 Paper on Regeneration Theory," the paper said to have started the frequency-response field. The other will be delivered by A. C. Hall, another early contributer to the field, on "Early History of the Frequency-Response Field."

Much credit for the organization and work involved in the setting up of this important symposium must go to the IRD Dynamic Systems Committee, to the reviewers of papers, and to the companies whose financial contributions made possible the participation of the foreign experts.

IRD to Present Award to H. W. Ziebolz

At a luncheon on December 1, the Instruments and Regulators Division will present a

Registration Schedule

Sun., Nov. 29	2:00 p.m. to 5:00 p.m.
Mon., Nov. 30	8:00 a.m. to 8:00 p.m.
Tues., Dec. 1	8:00 a.m. to 8:00 p.m.
Wed., Dec. 2	8:00 a.m. to 4:00 p.m.
Thurs., Dec. 3	8:00 a.m. to 8:00 p.m.
Fri., Dec. 4	8:00 a.m. to 3:00 p.m.

Fees for Nonmembers

A registration fee of $5 will be charged nonmembers attending the 1953 Annual Meeting of The American Society of Mechanical Engineers. The fee for student nonmembers will be $1.

The following nonmembers will be exempt from the payment of the registration fee:

Immediate family of a member (any grade)

Authors listed in the program or their appointed representatives

Invited discussers

Session chairmen and vice-chairmen

Committeemen required to attend a meeting of their committee

Session aides

Members of the Woman's Auxiliary to the ASME

Members of The Engineering Institute of Canada

Members of societies listed in the program

Distinguished guests invited by the President or Secretary of the Society

citation to Herbert W. Ziebolz, vice-president of engineering, Askania Regulator Co. Mr. Ziebolz took the engineering equivalent of an MS from the Technische Hochschule at Breslau, Germany, in 1925. He did postgraduate work in thermodynamics and mathematics, and was an assistant lecturer at the University of Breslau. Awarded a VDI travel scholarship, he was in the United States as an exchange student for two years, 1926-1928. He immigrated to this country in 1931 and has been with Askania ever since. He has written various papers on the design and application of automatic controls and the book, "Analysis and Design of Translator Chains." He holds 58 patents on electronic and hydraulic devices and has been responsible for major developments in instrumentation for submarines.

The award, which goes this year to Mr. Ziebolz, was established by IRD in 1950, to signalize outstanding achievement in the field of the Division's interest and to stimulate instrument people to new successes. Prior recipients have been Clesson E. Mason, Charles S. Draper, and Albert F. Sperry.

Symposiums and Panels

Sixteen symposiums and panels are on this year's Annual Meeting program, indicating the increasing interest taken in these events each year. These discussions on timely and important subjects serve to add spice to the regular fare of technical sessions at an Annual Meeting.

Another important symposium will be held on the timely subject of the problems of management in the automatic-factory age. Because of the widespread implications of this subject, six Divisions of the Society are jointly sponsoring the symposium. Problems of engineering, economics, and organization will be discussed at the all-day session. Eight papers are on the program.

The Heat Transfer Division has two symposiums planned. One is an all-day session with 12 papers on physical properties and the other is on attachment of tubes to tube sheets.

Progress toward industrial atomic power will be discussed at a panel arranged by the Nuclear Energy Committee.

The Management Division and the Junior Committee are cosponsoring a panel discussion on formal industry-training programs compared with "on-the-job" training of young engineers.

Other symposiums and panels scheduled include: Power Test Codes Committee symposium on evaluation of experimental uncertainty and design of engineering experiments; Railroad-Lubrication symposium on the technical aspects of the hot-box problem; Oil and Gas Power panel on filtration of fuel oil, and the Power-Fuels Panel on manpower and other factors affecting operating costs.

O. A. Saunders to Address Heat-Transfer Luncheon

Prof. O. A. Saunders of the Imperial College of the University of London, will be the speaker at the Heat Transfer Division's Annual Luncheon which will be held on Tuesday, December 1. Professor Saunders has been in this country in connection with a lecture tour including the Universities of Minnesota, Ohio State, Pennsylvania, Michigan State, Purdue, Delaware, Pennsylvania State College, and Illinois Institute of Technology.

Professor Saunders was the chairman of the European Committee which organized the General Discussion on Heat Transfer held in London in September, 1951. He is well known in the field of heat transfer and is a coauthor of the book entitled "An Introduction to Heat Transfer," by Fishenden and Saunders. Professor Saunders was appointed to the University of London chair of mechanical engineering at the Imperial College of Science and Technology in 1946. During World War II he worked for the Ministry of Aircraft Production on special investigations on internal-combustion engines, and he later joined the Directorate of Turbine Engine Research, in which he was in charge of research on jet propulsion and gas turbines.

Professor Saunders is chairman of the Propulsion Subcommittee and a member of the Council of the Aeronautical Research Council, chairman of the Mechanical Engineering Panel of the Ministry of Supply Gas-Turbine Collaboration Committee and chairman of the Submarine Propulsion Subcommittee of the Admiralty Scientific Advisory Panel.

Official Notice

ASME Business Meeting

THE annual business meeting of the members of The American Society of Mechanical Engineers will be held on Monday, November 30, 1953, at 5:00 p.m., at the Hotel Statler, New York, N. Y., as a part of the Annual Meeting of the Society.

Members are urged to attend.

Towne and Wright Lectures

This year the Annual Meeting will feature two of the four lectures with which ASME honors outstanding engineers and leaders—the Henry R. Towne Lecture and the Roy V. Wright Lecture. The Towne Lecture will be delivered on Tuesday, December 1, at 5 p.m. This lecture honors Henry R. Towne, president of the Society in 1889. It provides an opportunity for an outstanding leader in the field of management, economics, or business to discuss his experience related to the scientific method in industry or business. The 1953 Towne Lecturer is Philip M. McKenna, president, Kennametal Inc., Latrobe, Pa. His subject is "Economics and the Engineer."

The Roy V. Wright Lecture will be delivered on Wednesday, December 2. This lecture was initiated as a tribute to Roy V. Wright, president of the Society in 1931, in recognition of his services in the field of civic affairs. By means of this lecture the Society hopes to impress on engineers and young people the duties, responsibilities, and privileges of citizenship in a democracy. The Wright Lecturer at this meeting is Thomas Millsop, president of the Weirton Steel Company. Mr. Millsop is also the recipient of the 1953 Grant Medal, which will be presented to him at the Meeting. This medal is sponsored jointly by ASME and the American Management Association.

Annual Banquet

The high point of every Annual Meeting is the Annual Banquet, which this year will be held on Wednesday, December 2. The speaker will be Gwilym A. Price, president, Westinghouse Electric Corporation, Pittsburgh, Pa. As usual, new officers of ASME for the coming year will be introduced to members and guests at the banquet. In addition, there will be the annual honors ceremonies at which various high honors and awards will be presented to outstanding leaders and engineers who have made contributions to the engineering profession.

This year there is a new award. This is the ASME George Westinghouse Gold Medal which will be bestowed for "eminent achievement or distinguished service in the field of mechanical engineering." It was instituted at the 1952 ASME Annual Meeting to perpetuate the value of the rich contributions to power development made by George W. Westinghouse, Hon. Mem. and 29th president of the Society. First award of the gold medal will be made to Alexander G. Christie, Hon. Mem. ASME. Other important honors to be awarded include: ASME Medal to Crosby Field, Fellow ASME; Holley Medal to Philip Mowry McKenna; Worcester Reed Warner Medal to William H. McAdams; Melville Medal to Jefferson C. Falkner, Fellow ASME; Richards Memorial Award to Thomas Melvin Lumly; and the Pi Tau Sigma Gold Medal Award to Merl Baker.

Members and Students Luncheon

The Members and Students Luncheon provides an annual opportunity for older and younger members of the Society to get together in a congenial atmosphere of mutual good fellowship.

The luncheon is usually well attended. It is very popular with students and young engineers who come to witness the presentation of the Charles T. Main and Student Awards and to hear the interesting talks which are a feature of this luncheon.

American Rocket Society

The American Rocket Society, an affiliate of ASME, will hold its three-day annual meeting concurrently with the Annual Meeting. The American Rocket Society is recognized as the leading American technical group in the rocket industry. This year's meeting will be the largest annual meeting ever held by the ARS. The ARS meeting will be held at the McAlpin Hotel beginning on Wednesday, December 2. Twenty-five papers will be presented at seven technical sessions on such subjects as rocket and turbine testing, rocket-motor design, and liquid properties, handling, and analytical procedures. One of the main features of the ARS program will be a symposium on space at which there will be seven speakers. This is expected to be very popular. Another high light will be the Annual Honors Night Dinner on Thursday at which the speaker will be Maj. Gen. Donald L. Putt, Commander, Air Research and Development Command, U. S. Air Force.

SESA

Some of the ASME applied-mechanics sessions will be held in co-operation with the meeting of the Society for Experimental Stress Analysis. The SESA meeting begins on Wednesday, Dec. 2, and continues until Friday. On the program are five sessions and a luncheon. S. Timoshenko, Hon. Mem. ASME, Stanford University, Palo Alto, Calif., will deliver an address on the stress-concentration problem in the history of strength of materials. Symposiums on fatigue-testing methods and strength at elevated temperatures are scheduled.

Social Events

The first of the many social events at the Annual Meeting is to take place on Sunday afternoon, Nov. 29. This event will be a reception at the Engineering Woman's Club at Washington Square. On Monday there will be the President's Luncheon and a tea dance at 4 o'clock. There are four luncheons on Tuesday, Dec. 1. O. A. Saunders, Imperial College, University of London, London, England, will speak at the Heat-Transfer Luncheon. The speaker at the Fuels Luncheon will be Alfred Iddles, president, The Babcock & Wilcox Company, New York, N. Y., who will talk on "Power Today and Tomorrow." The Aviation Division and the IRD Division will also hold a luncheon. Tuesday evening the Applied Mechanics Dinner will be held. Alan T. Waterman, director, National Science Foundation, will present a progress report on the National Science Foundation at this dinner. The Hydraulics Old Timers' Dinner, a favorite with members, will be held the same night.

On Wednesday there will be an Honors Luncheon presided over by F. S. Blackall, jr., retiring president of ASME. First award of the Machine-Tool and Economic-Value Awards will be made at this luncheon. There will also be an address by Herbert L. Tigges, president of the National Machine Tool Builders' Association, which established the awards. The Gantt Medal will be presented at this luncheon. Thursday, the Members and Students Luncheon is scheduled. Three luncheons are on the program for Friday. At the Wood Industries Luncheon, Cyril Ainsworth, technical director of the American Standards Association, will speak. R. J. S. Pigott, past-president ASME, is the speaker at the Petroleum Luncheon. An address on new trends in textile education will be a feature of the Textile Luncheon.

Women's Program

The following interesting events have been arranged for the guests attending the Annual Meeting:

Sunday: Nov. 29, 4:00 p.m., reception at the Engineering Woman's Club.

Monday: Nov. 30, 12:15 p.m., President's Luncheon, Hotel Statler. 4:00 p.m., Tea Dance, Hotel Statler.

Tuesday: Dec. 1, 11:00 a.m., Welcome Wagon Tour. 12:30 p.m., Annual Luncheon and Fashion Show, Pierre Hotel. 8:15 p.m., Coffee and entertainment, Hotel Statler.

Wednesday: Dec. 2, 9:30 a.m. to 12:15 p.m., Annual Meeting of Auxiliary. 12:30 p.m., Luncheon, Tavern-On-The-Green. 7:00 p.m. Banquet.

Thursday: Dec. 3, 10:30 a.m., Navy Yard Tour and Luncheon at Officer's Club, Brooklyn Navy Yard.

Tool Exposition

PHILADELPHIA'S Convention Center will be the site of the tenth biennial American Society of Tool Engineers' Industrial Exposition, April 26–30, 1954. "Although the official announcement is being made now, industry's recognition of the importance of the 1954 Exposition is seen through the scores of letters already received, requesting space reservations," Harry E. Conrad, executive secretary of the Society, said.

Complete integration of the daytime technical sessions of the 22nd annual national meeting of the ASTE with the Exposition will be possible because all the sessions will be held inside Convention Center. Floor plans and regulations for the Exposition are being made available now from the Society's headquarters at 10700 Puritan Ave., Detroit 21, Mich.

ASME Student Conference Region I

ATTENDANCE at the annual ASME Student Conference, Region I, held at the University of New Hampshire, Durham, N. H., in April, 1953, exceeded 200, including delegates, Honorary Chairmen of the conference, guests, and students from the host college.

Official delegates were present from all 14 of the Region I student branches. Also present was A. C. Crownfield, secretary, Region I.

The function of this conference, like others held throughout the country, is to provide students with the opportunity to speak in public and to give them a sense of responsibility toward their Society and profession.

Reports of the 11 other regional conferences were recorded in the October issue of MECHANICAL ENGINEERING; however, copy of the proceedings of the Region I Conference was received too late for publication at that time.

Eleven papers were presented at the two technical sessions. Prize winners, as determined by 27 judges including the Honorary Chairmen and the Student Chairmen, were scored as shown in Table 1.

ASME Membership as of Sept. 30, 1953

Honorary Members	53
Fellows	379
Members	13,856
Associates	336
Juniors (33 and over)	3,357
Juniors (30–32)	1,993
Juniors (to the age of 29)	18,489
Total	38,463

"Man-Mile" Trophy

Computations based on student registration at the conference determined the winner of the "Man-Mile" Trophy to be Northeastern University, Boston, Mass., with a total of 4600 man-miles recorded. Man-miles are the product of the number of delegates at the technical sessions, by the distance of delegates from their college. Northeastern had 72 delegates, and its distance from Durham is 64 miles. Rivalry in competition for this trophy stimulates interest in better attendance at all conferences.

The Thayer School of Engineering, Hanover, N. H., won first prize for the greatest percentage of its membership present. Thayer was also awarded a certificate for enrolling the largest percentage of student members.

Inspection tours of the Portsmouth Naval Shipyard and of the floating power plant, "Resistance," were arranged by Captain L. N. Blair, Commander of the Portsmouth Naval Shipyard, and Roger Hunt, Division Engineer of the Public Service Company of N. H.

Dr. Donald Chapman, Banquet Speaker

At a banquet held at the University dining hall, the speaker, Dr. Donald Chapman, Professor of Geology, University of New Hampshire, lectured on "Norway and Her Neighbors," assisted by Mrs. Chapman in the presentation of colored slides. After the banquet, Dean and Mrs. Seeley entertained the Honorary Chairmen and guests of the conference at their home.

Honorary Chairmen held an informal breakfast meeting to discuss such matters as conference location for 1954, man-mile trophy changes, freshman-sophomore membership problems, ways of stimulating student interest, and general program objectives of future ASME Student conferences.

TABLE 1

Prize	*Recipient*	*Title of Paper*	*College*
First	M. L. Thorpe	Pilot-Flame Stability for Turbojets	Thayer School of Engineering
Second	J. L. Miller	A Frequency-Modulation Strain-Gage Telemetering System	Northeastern University
Third	J. M. Greenbaum	The Electronic Analog—A Means of Rapid Solution to Industrial Problems	M.I.T.
Fourth	R. E. Chiabrandy	The Conversion of a Springfield Rifle to a Sporting Rifle	Worcester Polytechnic Institute
Fifth	J. N. St. Pierre	The Heat Pump as a Hot-Water Heater	University of Massachusetts
Sixth	D. Westbrook	Formation Sampler	Clarkson College of Technology

The President's Page

Some Random Thoughts on Publications Policy

ONE of the great services of our Society to its members and the general public is rendered in its role as editor and publisher. In addition to MECHANICAL ENGINEERING, the Society produces several periodicals, a mechanical catalog, a myriad of codes, standards, manuals, reports, and reviews, and a substantial number of books annually. To many, though by no means all, this function is the most vital service which the Society performs. Certainly it is one of its major points of contact with the general public. Thus the policies which the Society pursues and the quality of product which it turns out should be a matter of the utmost concern to its members.

Now the reading public is fickle, as is attested by the fate of some of the great magazines and publishing houses of yesteryear which have vanished into oblivion, because, perhaps, they lost the feel of the public pulse.

For this reason, ASME should scrutinize its publications policy constantly and attempt to keep it at all times up to date and responsive to the members' wishes. To this end, it has an active Publications Committee, which has been studying the whole problem for several months past. Some of its recommendations will become evident over the next few months.

One of them, already in effect, has been to make more preprints available without charge. Another is to institute a more effective review of papers to be considered for publication. The Publications Order Department has been reorganized to provide rapid dispatch in filling orders for technical papers and the like. These are all steps in the direction of the sort of efficient operation which rightly should be expected of an engineering society.

Of course, in any reappraisal of publications policy, the style, format, content, and character of our great engineering journal, MECHANICAL ENGINEERING, inevitably looms as the central core of the problem. The late Elbert Hubbard once said, "It's a wise man who does not monkey with his destiny." We must take care in our anxiety to be modern, not to discard the seeds of greatness.

MECHANICAL ENGINEERING, by any standards, is one of the leading engineering periodicals of the world. It is widely read and respected. It attracts, on a competitive basis, an impressive list of national advertisers. Its editorial policy is, as it always should be, on a high plane. Our problem simply is to keep it there and, if possible, to broaden its influence. How can we do this?

I somehow think that MECHANICAL ENGINEERING should hitch its wagon to a star and seek to be the one recognized authoritative source of technical news of the mechanical-engineering profession of our nation. This would involve an increased outlay for editing and printing. It would certainly necessitate a greater proportion of staff writing and reporting. It would require prompter news coverage at the high technical level, but as a scientific journal, not simply a newspaper.

But perhaps a better balance between top-grade papers and top-grade technical reporting would make for a better magazine, one which would command more attention, speak with more authority. We might even seek some increase in the nonmember circulation, which presently amounts to about 3000 copies per month. Such a policy could conceivably earn more advertising revenue. It could be a cogent force in developing additional memberships. And how better could we carry the story of our profession's and our Society's accomplishments to the public?

In the matter of format, readability, and appearance, I should like to see MECHANICAL ENGINEERING set in a larger type face. The judicious use of color and bleed, as well as a more profuse employment of modern photographic techniques might lend a greater measure of reader appeal.

These are but a few random thoughts of your President on a highly complex and frequently controversial subject. The editor and the management are well aware of them, indeed have some of them under active consideration.

Times and reader habits change. Engineering and progress have always been synonymous. So they should be in this important phase of our Society's activities.

The editor of MECHANICAL ENGINEERING, the Publications Committee, and the administrative officers of your Society will always welcome any questions leading to improvement in the Society's publications.

FREDERICK S. BLACKALL, JR., *President*
The American Society of Mechanical Engineers

ASME Fall Meeting Held in Rochester, N. Y.

RES and EIC Participate

WITH more than 750 engineers from many parts of the United States and Canada in attendance, the Rochester Section played host to The American Society of Mechanical Engineers, which held its three-day Fall Meeting at the Sheraton Hotel, Rochester, N. Y., October 5–7, in co-operation with the Rochester Engineering Society and the Engineering Institute of Canada. Besides the participation of EIC, the meeting took on additional international flavor with the presentation of the Calvin W. Rice Lecture by J. Foster Petree, editor of *Engineering*, London, England, and the Honorable Robert Winters, Minister of Public Works, Ottawa, Ont., Can., who was the principal speaker at the banquet.

An outstanding technical program, consisting of 19 technical sessions which included 44 papers, a symposium, and two panel discussions, offered a wide variety of valuable engineering information to the attending engineers. In addition, the program included the presentation of the Roy V. Wright Lecture at one of the two luncheons, a banquet, numerous inspection trips to Rochester's leading industries, and special activities for the women.

ASME Standards Discussed at President's Luncheon

At the President's Luncheon on Monday, the first general function of the meeting, ASME President F. S. Blackall, jr., speaking on the subject, "ASME Standards Save Lives and Dollars," declared that the ASME Program of Codes and Standards is one of the Society's greatest contributions to the public welfare, to national defense, and to the nation's industry. This program, he said, is an outstanding example of co-operative effort, with some 3000 of the country's best engineering talent contributing their time and effort continuously and voluntarily to more than 350 separate projects incident to it.

Mr. Blackall cited the ASME Boiler Code which has been made the basis of laws enacted by 20 states and 23 municipalities and thereby has become enforceable by state or local authorities. In addition, he revealed that every one of the Canadian Provinces has adopted the Code in whole or in part. As a result, no boiler for steam-power-generating purposes is made or could be sold in this country or in Canada which does not bear the ASME seal indicating that it meets the minimum standards established by the ASME Boiler Code. Also extremely important as a guardian of public safety is the ASME Code for Unfired Pressure Vessels, he said.

Primarily as a result of the ASME Boiler Code, Mr. Blackall said, boiler explosions and the frightful loss of life and property attending them, which once were commonplace, today are a rarity.

Other guardians of public safety which have found their way into law, and discussed by Mr. Blackall, include the ASME Elevator Code, the Plumbing Code, the Code on Manlifts, and the ASME Uniform Smoke Ordinance. Many, not enacted by law, but adopted voluntarily by industry with immediate and striking reductions in the accident rate, include safety codes for cranes, hoists, and derricks, and compressed-air machinery.

J. FOSTER PETREE DELIVERING RICE LECTURE

A striking example of the contributions of ASME Standards to the nation's defense, cited by Mr. Blackall, is the recent adoption of a screw-thread accord by the United States, Great Britain, and Canada—the ABC Screw Thread. As a result, American screw threads today, on all munitions of war and an increasing number of commercial products, will interchange with those of the whole British Empire.

Mr. Blackall also pointed out that ASME has rendered yeoman service in devising standards for symbols, nomenclature, abbreviations, drafting-room practice, graphs, and charts. Also completed is a proposed American Standard for terms employed in nuclear-energy development. He added that much standards work has also been done in the fields of measurement and evaluation such as the Power Test Codes and the Standards for Instruments and Apparatus.

C. W. deKiewiet, president, University of Rochester, Rochester, N. Y., presided.

J. Foster Petree Delivers Rice Lecture

This year's Calvin W. Rice Lecturer, J. Foster Petree, editor, *Engineering*, London, England, discussed "The Position of the Technical Press in Relation to Industry." Mr. Petree defined a technical journal as one that maintains an editorial staff of men whose training has been primarily technical and who are competent to discuss with their readers and contributors, on reasonably equal terms, the technicalities of the field with which the journal purports to deal; and, he emphasized, the journal should be in a position to take an independent line on matters of technical controversy, without regard to purely commercial influences.

In considering the present and future position of the technical press in relation to industry, he said it is desirable to consider what functions a technical journal should discharge. These functions, according to Mr. Petree, are (1) presenting current news of technical prog-

ATTENDING THE PRESIDENT'S LUNCHEON WERE, *left to right:* ROSS L. DOBBIN, PRESIDENT, ENGINEERING INSTITUTE OF CANADA; OSCAR S. FIELD, PRESIDENT, ROCHESTER ENGINEERING SOCIETY; ASME PRESIDENT F. S. BLACKALL, JR.; AND J. FOSTER PETREE, PRESIDENT, THE NEWCOMEN SOCIETY

ress; (2) reporting events of technical interest; (3) sifting, and often discovering and translating, reports; (4) reviewing technical books; (5) providing informed comment, and the opportunity for readers to comment also, thus helping to mold technical opinion; and (6) providing advice and special information when this is asked for.

Basically speaking, therefore, Mr. Petree emphasized that the main function of the technical press is educative—that of making available to the engineer, as widely as possible and with due discrimination, the experience of others in his own and related fields—the related fields being particularly important at the present day, when developments in one direction, such as metallurgy and electronics, may be the key advances in many others. Engineers, after all, he pointed out, learn their art and science almost entirely by experience—their own, that of their predecessors, and that of their contemporaries.

President Blackall, who presided, explained prior to Mr. Petree's address, that the Calvin W. Rice Lecture was founded in 1934 and was named to honor the man who served as Secretary of the Society from 1906 to 1934, to further two ideals he had fostered. These were to increase understanding between the engineers of the various countries and to stimulate the programs of meetings other than the Annual Meeting. For his lecture, Mr. Petree was elected a Life Member of ASME.

Wright Lecture Presented by Carey H. Brown

On Tuesday, at a joint Rochester Engineering Society-ASME luncheon, Carey H. Brown, Mem. ASME, manager of engineering and manufacturing services, Kodak Park Works, Eastman Kodak Company, Rochester, N. Y., gave the Roy V. Wright Lecture on "The Engineer and His Community." Mr. Brown revealed that there are numerous factors which are tending to increase the pressure for more instruction of engineering students and others, in the humanities and social sciences. This, he said, is because engineers and scientists, in major numbers, are considered introspective and inhibited.

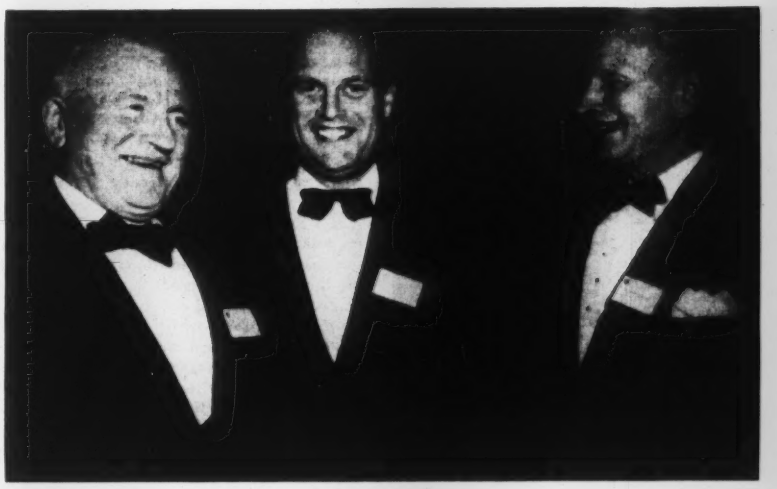
WRIGHT LECTURE IS PRESENTED BY CAREY H. BROWN DURING RES-ASME LUNCHEON

The sum total of civic tasks, wherein the citizen may practice his social science, is enormous, he said. There civic tasks fall into two main categories—those which are carried out by governmental agencies, and those which are carried out by volunteer nongovernmental agencies. Examples of the first are federal, state, county, city, and other local governmental activities. Examples of the second are the numerous directors, trustees, or other volunteer workers in educational institutions, hospitals, social agencies of various types, Chambers of Commerce, professional organizations, service clubs, and the like.

For example, he said, it is necessary that engineers be on the alert to assure that engineering activities of governmental agencies are so conducted that decisions on engineering matters are reached on the basis of engineering judgment and that the latter is not sacrificed for political considerations when the latter are at variance with the former. In addition, he declared, the engineer in the role of good citizen must be alert to exercise his right of suffrage. Statistics as to the number of citizens who fail to vote are startling.

Touching on the nongovernmental side, Mr. Brown pointed out that the boy destined to become an engineer, who grows up in an environment influenced by the YMCA or the Boy Scouts; his education (in college, at least), only partially paid for by his tuition, is in large part subsidized by the taxpayer, the public, or the philanthropist. He makes his way in a world very many of whose good things are dependent upon the volunteer effort of men and women inspired by the desire that the world of their children be better than their own world. The engineer should be able to contribute some of his own time and effort in return for these benefits.

Mr. Brown concluded that maintenance of our institutions is dependent upon the civic consciousness of the individual citizen and his active participation in the affairs of his community.



CANADA'S REPRESENTATIVES AT FALL MEETING INCLUDED, *left to right*, ROSS L. DOBBIN, PRESIDENT EIC, THE HON. ROBERT WINTERS, WHO WAS THE BANQUET SPEAKER; AND L. AUSTIN WRIGHT, GENERAL SECRETARY, EIC

Carl L. Bausch, Fellow ASME, vice-president in charge of engineering and research, Bausch & Lomb Optical Company, Rochester, N. Y., presided.

R. Winters of Canada Addresses Banquet

More than 250 ASME members and guests in attendance at the Banquet on Tuesday evening, the main social event of the meeting, heard The Honorable Robert Winters, Minister of Public Works, formerly Minister of Resources and Development, Ottawa, Ont., Can., speak on "The Engineer and Natural Resources." He pointed out that Canada's standard of living is now near enough to that in the United States that for practical purposes it can be said that Canada's use of raw materials, both in kind and volume, is about the same as the American per capita rate. But, he said, Canada's rate of disappearance is greater in some cases because that nation produces and exports, for example, about 80 per cent of the world's nickel, half of its platinum, and two thirds of its asbestos. Canada ranks second in zinc and gold production among the nations of the world, third in silver, and fourth in copper. Canada also supplies about 30 per cent of world exports of wood pulp and 80 per cent of newsprint exports. Canada, Mr. Winters explained, is a nation of barely 15 million people, but it produces and exports surpluses from its rich storehouse of natural resources to such an extent that it is the third trading nation in the world.

Back of this record of development and utilization of natural resources, he said, is the engineer.

As further examples, Mr. Winters cited such significant Canadian developments as the Quebec-Labrador iron-ore development, the discovery of new oil fields in Alberta in 1947, the huge aluminum undertaking at Kitimat in the north coastal mountains of British Columbia, nickel-copper production in north-

ENJOYING CHAT DURING BANQUET ARE ASME PRESIDENT-ELECT LEWIS K. SILLCOX, *left*, AND PRESIDENT BLACKALL

ern Manitoba, and the location, recently, of uranium in many places in Canada.

Other Canadian natural-resource developments that recently have been commanding the attention of engineers, Mr. Winters indicated, include the following: Lead-zinc-silver in the Mayo district of the Yukon; asbestos in northern British Columbia, prospects of base metals at Pine Point near the west end of Great Slave Lake; nickel prospects at Rankin Inlet on the west coast of Hudson Bay; iron-ore deposits discovered at Payne Bay, on Quebec's far northern coast; lead and zinc prospects near Bathrust, New Brunswick; titanium production at Allard Lake, Quebec; and the discovery of copper deposits in the Gaspé country.

Mr. Winters also revealed that with less than one per cent of the world's population, Canada develops more than 10 per cent of the world's hydroelectric energy.

By suggestion and advice—broadly, the tools of education—the engineer, he pointed out, can induce a thoughtful approach to development and utilization, even to the point of convincing hard-headed finance that today's quick profits are apt to prove much too costly if they should contribute to less productivity of the resource at some future date.

As part of the program, Edward Peck Curtis, vice-president, Eastman Kodak Company, who was the banquet toastmaster, called on President Blackall to make presentations of 50-year pins to three ASME members. Mr. Blackall called on the recipients—Albert Gifford, treasurer, Leland-Gifford Company, Worcester, Mass.; H. F. Halladay, mechanical engineer, New York Air Brake Company, Watertown, N. Y., and F. A. Haughton, Schenectady, N. Y.—but they were unable to be present.

Technical Program

The Fall Meeting technical sessions, to which many of the Society's Divisions contributed papers, contained an abundance of engineering material and covered a wide scope. A technical high spot was the Symposium on Industrial Uses of Photography and Optical Instruments, sponsored by the Rochester Section. It was pointed out that the high-speed motion-picture camera is an ideal instrument for the analysis of most types of very rapid motion occurring too fast for the eye to see. As part of another paper, motion pictures of the X-5 jet plane, the first to be flown with variable swept-back wings, were shown. Also discussed were the means by which optics are used for engineering measurements. Measuring with light, it was reported, results in speed and saving of materials in many fields as varied as steel mills, canning factories, and hospitals.

In a Production Engineering Division paper on machine-tool replacement, it was pointed out that a definite plant program for replacing machine tools and productive equipment is necessary to keep down costs. Any equipment, it was said, which does not meet the challenge of new and more modern machines must be displaced, regardless of its age or condition and whether it is physically worn out.

Conveyers, according to a Materials Handling Division paper, are now being developed to perform complex operations, with emphasis on automation, created by the need for cost reduction and increased production, with uniform improved quality.

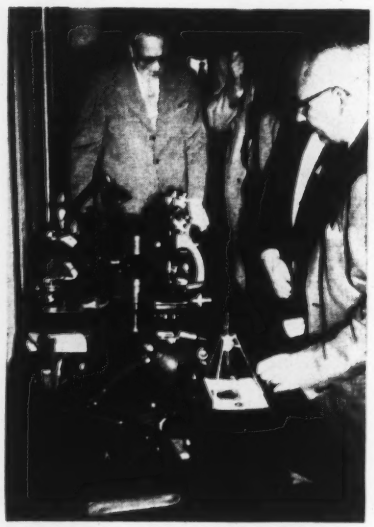
Along similar lines, a paper presented during a Machine Design Division session gave an illustration of automatic assembly. The era of automation is gaining momentum, the paper said, because of the ever-increasing demands of labor and the resulting demands of management for greater productivity per capita.

A Fuels Division paper described coal-handling facilities which are being designed with automatic remote-control features. Lower installation and operating costs are expected to result.

Besides taking up power-plant design considerations and reheat-station operating experiences, Power Division papers dealt with features of the regenerative air preheater, centrifugal boiler feed pumps, turbine starting and loading, and a procedure for the solution of pipe-line flexibility problems by the use of punched-card machines.

Papers were also presented in Process Industries, Metal Processing, Safety, Heat Transfer, and Instruments and Regulators. In addition, two panels were also included on the program. The Management Division discussed "What Are the Specifications for an Effective System of Standard Data?" and the Education Committee covered "The Competitive Professional Attitude."

OPERATION OF HIGH-SPEED MOTION-PICTURE CAMERA AND GOOSE CONTROL UNIT IS DEMONSTRATED DURING SYMPOSIUM



DISPLAY OF OPTICAL INSTRUMENTS FOR ENGINEERING MEASUREMENTS AT SYMPOSIUM ON INDUSTRIAL USES OF PHOTOGRAPHY AND OPTICAL INSTRUMENTS ATTRACTS ATTENTION OF ENGINEERS

A list of the available Fall Meeting preprints, arranged by Division and number, appears on page 911 of this issue. Digests of the available preprints will be published in forthcoming issues of MECHANICAL ENGINEERING.

Inspection Trips

To give some idea of Rochester's diversified industries, plant trips to seven leading companies took place on Tuesday and Wednesday afternoons during the Fall Meeting.

Taylor Instrument Companies, Bausch & Lomb Optical Company, and Gleason Works were visited on Tuesday by three groups. On Wednesday, Eastman Kodak Company, the Pfaudler Company, Rochester Gas and Electric Corporation, and Mixing Equipment Company, Inc., were hosts to four groups.

Taylor Instrument Companies

At Taylor, the visitors saw the manufacture of consumer items such as household thermometers, hydrometers, meteorological instruments, barometers, and blood-pressure instruments; and industrial instruments for indicating, recording, and controlling temperatures.

Bausch & Lomb Optical Company

The high-speed, semiautomatic processes for manufacturing ophthalmic products and scientific instruments were inspected at Bausch & Lomb. It was pointed out that the equipment was designed and built solely by engineers at the optical firm, which is celebrating its 100th anniversary this year.

Gleason Works

The group touring Gleason saw production

of machine tools for cutting, grinding, lapping, burnishing, testing, flame-hardening, and quenching straight, Spiral and Zerol bevel gears, and Curvic couplings.

Eastman Kodak Company

At Kodak Park, the facilities for manufacturing photographic papers, films and chemicals, synthetic organic chemicals, and processing of colored films, were shown. Also visited were the company's research laboratories and the distribution center for shipping all the products manufactured in the four Rochester plants.

The Pfaudler Company

Production of glassed-steel process equipment and alloy equipment for the chemical, pharmaceutical, brewing, food, dairy, and beverage industries were seen at Pfaudler. Types of equipment shown included reactors, storage tanks, heat-exchange towers, distillation assemblies, and filling machines.

Rochester Gas and Electric Company

At the Russell Station, which has a capacity in excess of 200,000 kw, a group inspected the boiler-generator combinations which are of the unit-system arrangement. Fuel is pulverized, dust is removed by electrostatic means, and circulating water is obtained from a pipe line 3600 ft in the lake.

Mining Equipment Company

Here, the visitors saw the engineering, research, and production facilities for manufacturing mixing equipment.

Women's Program

An interesting series of events were arranged for the women at the meeting. On Monday there was an all-day trip. In the morning the guests enjoyed a tour of Kodak Park of the Eastman Kodak Company. After a luncheon in the recreation building, guests were taken on a two-hour tour of Rochester. The group then visited the Eastman School of Music and had tea at the Rochester Club. In the evening there was a visit to the George Eastman House which is now a photographic museum. Here the group saw the earliest cameras, an interesting collection of photographs past and present, and the latest developments in photography in color, x ray, aerial, and the like. There are 50 rooms and 10 acres of gardens. On Tuesday the banquet was held. A style show and brunch at Sibley, Lindsay and Curr Company was on the program Wednesday morning. In the afternoon tours were arranged to such points of interest in Rochester as the Susan B. Anthony House, the Memorial Art Gallery, and the Bausch Museum.

Committees

The committees in charge of arrangements for the Fall Meeting included the following: *General Committee*, C. L. Bausch, *chairman;* E. R. Birkicht, *vice-chairman; Plant Trip*, H. Ashcroft, Jr., *chairman;* P. Byrne, J. Davidson, R. Edelman, B. Frank, K. H. Grim, G. Lawrence, G. Morrison, H. Novak, R. Ross, E. Seymour, F. Sgambaty, H. Swan, J. Utz, J. Vonhold, Jr., and L. Zoss; *Technical Events*, A. S. Hamilton, Jr., *chairman;*

CHAIRMAN OF THE FALL MEETING GENERAL COMMITTEE, CARL L. BAUSCH, ACTS AS TOASTMASTER AT JOINT RES-ASME LUNCHEON

L. K. Ahrendsen, K. W. Brenner, C. F. Cala, E. M. Low, J. H. Klein, and R. L. Marcotte; *Information and Registration*, R. A. LeBlanc, *chairman;* W. E. Bergemann, J. G. Donaldson, L. M. Evans, T. F. Hooker, B. W. Huston H. A. Mosher, S. Russell, P. W. Seely, D. W. Shepardson, and J. R. Turner; *Publicity*, J. A. McConnell, *chairman;* M. S. Grass and W. H. Moore; *Reception*, S. C. Stacy, *chairman;* A. H. Candee, L. B. Darling, C. K. Flint, J. E. Gleason, P. M. Kimmell, A. B. Rogers, and F. R. Scherer; *Printing and Signs*, D. B. Vernooy, *chairman;* D. R. Bleier and J. S. Goldey; *Finance*, A. E. Schell, *chairman;* G. A. Leavitt and P. B. Wesson; *Hotel*, A. W. Schuster, *chairman;* J. Boor, J. W. Doolittle, R. W. Edwards, A. E. Koerner, N. H. Matthews, Jr., A. F. McCormack, Jr., J. Peragallo, and J. W. Royer; *Entertainment*, E. W. Neben, *chairman;* W. Bausch, G. T. Dibble, S. S. DiMaggio, and E. A. Edwards; *Women's Activities*, Mrs. P. M. Kimmell, *chairman;* Mrs. H. Ashcroft, Jr., Mrs. C. L. Bausch, Mrs. M. L. Baxter, Jr., Mrs. J. Baybutt, Mrs. E. R. Birkicht, Mrs. C. H. Brown, Mrs. L. D. Conta, Mrs. P. T. Elliott, Mrs. A. S. Hamilton, Jr., Mrs. G. E. Lawrence, and Mrs. J. A. McConnell.

Scientists and Engineers Attend Nuclear Conference at Berkeley

THE University of California was host to more than 225 outstanding nuclear scientists and engineers attending the 1953 conference on Nuclear Engineering at Berkeley, Calif., on September 9–11. The program covered unclassified technical papers on discussions by and for those concerned with the beneficial applications of atomic energy. The Conference was presented by the University's Departments of Engineering at Berkeley and Los Angeles in co-operation with Northern California Sections of AICE, AIEE, and ASM; Southern California Sections of ASME, AICE, and ASM; and the Committee on Atomic Energy Education of the ASEE.

Following the opening remarks by Prof. R. A. Fayram, General Conference Chairman, the attendees were welcomed by Dean M. P. O'Brien, Mem. ASME, and Dean L. M. K. Boelter, Fellow ASME. The technical program consisting of more than 50 papers was presented in ten sessions. Invited papers were presented by George L. Weil, consultant; H. A. Saller, Battelle Memorial Institute; and Dr. Edward Teller, University of California. Contributed papers covering the following subjects were presented: (1) Power and re-

FOREIGN SCIENTISTS, PROMINENT IN THE NUCLEAR FIELD, ADDED AN INTERNATIONAL AIR TO NUCLEAR CONFERENCE

Left to right: Dr. Arne Lundby, Joint Establishment for Nuclear Energy Research, Keller, Norway; Prof. R. A. Fayram, Gen. Conference Chairman and Division of Mechanical Engineering, University of California, Berkeley, Calif.; Prof. N. W. Snyder, Conference Vice-Chairman and professor of engineering, University of California, Berkeley, Calif.; Prof. T. J. Connolly, Conference Vice-Chairman, University of California, Los Angeles, Calif.; and Dr. Gunner Randers, Joint Establishment for Nuclear Energy Research, Keller, Norway.)

search reactors, (2) equipment for neutron research, (3) nuclear power—plant economics, (4) kinetics, instrumentation, and control, (5) materials, (6) accelerator engineering, (7) uses of isotopes and nuclear radiations.

Conference Proceedings

Bound copies of the Conference Proceedings are available at a cost of $7.50 from the California Book Company, 2310 Telegraph Ave., Berkeley 4, Calif.

Those attending the conference were privileged to tour the facilities of the University of California Radiation Laboratory including the 184-in. cyclotron and the new 6-BEV Bevatron.

The conference provided a new concerted opportunity for persons engaged in engineering work in the nuclear-energy field to present technical papers on selected results of their work. At the same time an opportunity was presented for engineers engaged in all phases of nuclear engineering to enlarge their knowledge of developments in the field and to become better acquainted with personnel having similar interests and problems. The success of the conference should encourage further unclassified conferences covering research and development engineering on both independent and AEC-supported bases.

J. T. Rettaliata Addresses Hydraulics Conference

J. T. RETTALIATA, Mem. ASME, and president, Illinois Institute of Technology, Chicago, Ill., delivered the keynote address at a banquet held for delegates at the ninth National Conference on Industrial Hydraulics, Oct. 8, 1953, at the Sheraton Hotel, Chicago, Ill.

The conference was sponsored by Illinois Institute of Technology and Armour Research Foundation of Illinois Institute to encourage rapid progress in the field of industrial hydraulics through the free exchange of current information.

In his address, "New Directions for Technology," Dr. Rettaliata stated that industry must improve its productivity if America is to support its population of 200 million persons expected by the end of the century.

The problem is complicated, said Dr. Rettaliata, by present trends toward reduction of the work week. He felt that a work week of 30 hours or less would materialize well before the end of the century. We will be faced, he said, with the problem of satisfying the demands of an expanding economy for a greater flow of goods at the same time that the people producing the goods are working fewer hours. The only solution is to increase output per manhour, the Illinois Technology president said.

Only an advancing technology can accomplish this job and give men more goods with less work.

Technological advances will continue to be made, said Dr. Rettaliata. However, he felt that these advances would only contribute to the productivity of the worker and not replace him.

ASME International Meeting in Mexico City

PLANS are presently under way and are shaping up for what promises to be one of the most interesting trips ever arranged by the Society for the members and their ladies who are going to attend the ASME International Meeting to be held in Mexico City, May 10–13, 1954. Transporation is being worked out from the States to Mexico and the trips in Mexico include visits to such fabulous places as Cuernavaca, Taxco, Mexico City itself, the pyramids and temples, Xochimilco, and Acapulco. Complete information will be published in the December issue of MECHANICAL ENGINEERING.

N. J. Hoff Presents 41st Wilbur Wright Memorial Lecture

THE forty-first Wilbur Wright Memorial Lecture was delivered by Prof. N. J. Hoff, Mem. ASME, Head, Department of Aeronautical Engineering, Polytechnic Institute of Brooklyn, on September 14, before the Royal Aeronautical Society in London, England. This lecture, presented in the fiftieth year after the epoch-making flight at Dayton, Ohio, and honoring the memory of Wilbur Wright, followed the precedent that in every second year the lecturer is to be an American citizen.

Professor Hoff, who has made considerable contributions to the science of aeronautical engineering, chose "Buckling and Stability" for the subject of his lecture and, after quoting an original letter now in the Library of Congress at Washington, in which Wilbur Wright had revealed his close attention to problems of structural strength, the lecturer referred in detail to his own research, both theoretical and practical, in which he has been taking account of rate and duration of loading in the strength of columns. He traced the modern theory of column strength from Sir Richard Southwell and Prof. Theodore von Kármán, both of whom were present in his audience, though both had published their most significant contributions to their problem over 40 years ago.

Ralph E. Flanders Awarded Standards Medal

RALPH E. Flanders, Hon. Mem. ASME and senior Senator from Vermont, has been awarded the nation's highest honor in the field of standardization. He received the 1953 Howard Coonley Gold Medal for "service in advancing the national economy through voluntary standards." Presentation was made at the annual award luncheon meeting of the American Standards Association held at The Waldorf-Astoria, New York, N. Y., recently.

Senator Flanders is a past-president of The American Society of Mechanical Engineers and of the National Machine Tool Builders Association. He has been active for many years in standardization work, particularly in the field of machine tools and screw threads. As chairman of the American Standards Association Committee on Standardization and Unification of Screw Threads in 1943, he presided over the first of a series of international meetings which resulted in creation of the unified and interchangeable screw thread now in common use in Great Britain, Canada, and the United States.

The Coonley Medal is awarded on the recommendation of a committee named by The American Society of Mechanical Engineers, The American Management Association, and the National Industrial Conference Board. Previous recipients of the award have been Howard Coonley, after whom the medal was named, 1950; Herbert Hoover, Hon. Mem. ASME, 1951; and William L. Batt, Hon. Mem. ASME, 1952.

Mechanical-Engineering Film

A FEATURE-LENGTH film in color entitled "Mechanical Engineering," covering training, job opportunities, and the future in the field of mechanical engineering, has been produced by the School of Engineering at Michigan State College, East Lansing, Mich.

Designed primarily for showings before high-school groups interested in engineering careers, the film includes scenes of training on the MSC campus and professional engineers at work in Michigan industrial plants.

An important feature of the film, it is pointed out, is the showing of the similarity of work done in training by the college student and work done by the engineer in industry.

The 20-min film was produced by Paul Dekoning, Mem. ASME, assistant professor of mechanical engineering, and George Tsuda, instructor in engineering drawing. The film will be shown to interested groups without charge.

Meetings of Other Societies

Nov. 12–13
Society of Naval Architects and Marine Engineers, 61st annual meeting. Waldorf-Astoria Hotel, New York, N. Y.

Nov. 23–34
ORSA. fall meeting. Hotel Statler, Boston, Mass.

Dec. 6–9
The American Society of Refrigerating Engineers. Shoreham Hotel, Washington, D. C.

Dec. 7–9
American Society of Agricultural Engineers, winter meeting. Edgewater Beach Hotel, Chicago, Ill.

Dec. 8–10
AIEE-ACM-IRE Eastern Computer Conference. Statler Hotel, Washington, D. C.

Dec. 13–16
American Institute of Chemical Engineers annual meeting. Jefferson Hotel, St. Louis, Mo.

Dec. 26–31
American Association for the Advancement of Science, Boston, Mass.

(*ASME Calendar of Coming Events, see page 939*)

Permanent Machine-Tool Exhibition Opens in Brooklyn, N. Y.

A DISPLAY of nearly 1000 of the latest machine tools from the United States, as well as France, Italy, Germany, Switzerland, Japan, and Great Britain, was put on exhibition at the First International Machine-Tool Exposition which opened recently in Brooklyn, N. Y. The exhibit is a permanent one and will be open six days a week. Located at 132 54th Street, Brooklyn, N. Y., the exposition covers an entire block.

The permanent exposition is sponsored by an industry-wide committee headed by Col. George Hartman of the Portland Machine Tool Works of South Portland, Me. It was originally conceived and organized by the S&S Machinery Company of Brooklyn. According to its sponsors, the exhibit is designed to fill the need for a permanent center for the display of American and foreign machine tools. The exhibit is said to be the largest assemblage of machine tools ever brought together under one roof on a permanent basis.

Featured at the opening of the exhibition were approximately 200 newly designed machines never exhibited here before. On display were the latest in large-size Italian boring mills, a new American low-cost contour grinder, a new Swiss automatic screw machine, a modern punch press from Chicago, an automatic electrocycle turret lathe from Bologna, a new openside hydraulic grinder from Germany, and milling machines from Italy.

All types of machine tools including production, fabricating, and toolroom equipment are on exhibit. Some other features include: A wide range of lathes from four different countries, many distinct types and sizes of grinding machines, some 22 different drill presses, and a large variety of boring mills and milling machines. In addition, the exposition includes demonstrations of many new metalworking techniques. All the machine tools are available for demonstration by trained technicians and sales engineers.

For the first time, this type of exhibit enables the machine-tool buyer to examine and test tools, under actual working conditions, in a variety of brands and styles at one location.

Exhibits will be changed as new designs and methods are developed. Space in the machine-tool exhibit is open, it is reported, to any domestic or foreign manufacturer who complies with the regulations and whose tools meet the standards of sponsoring committee.

ASME Calendar of Coming Events

Nov. 29–Dec. 4
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers was July 1, 1953)

March 10–12, 1954
ASME International Meeting, Hotel Del Prado, Mexico City, D. F.
(Final date for submitting papers was Nov. 1, 1953)

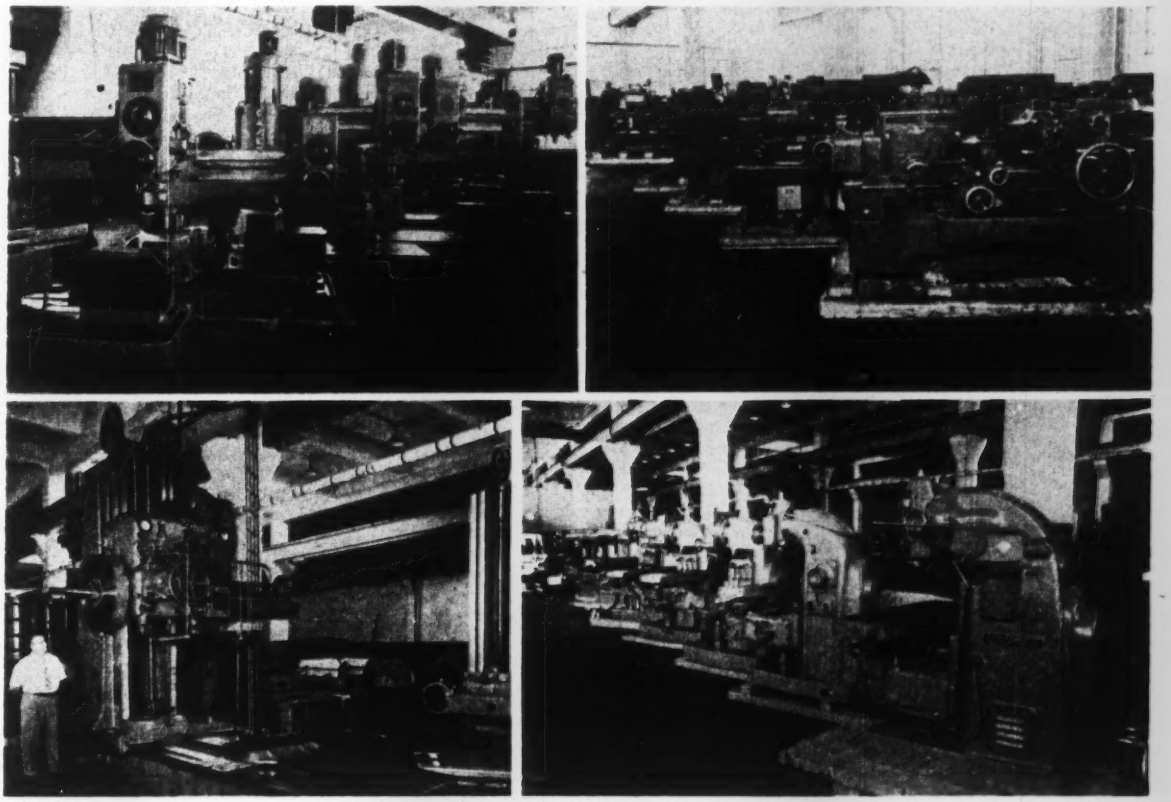
June 14–17, 1954
ASME Oil and Gas Power Conference, Hotel Muehlebach, Kansas City, Mo.
(Final date for submitting paper—Feb. 1, 1954)

June 20–24, 1954
ASME Semi-Annual Meeting, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers—Feb. 1, 1954)

Sept. 8–10, 1954
ASME Fall Meeting, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers—May 1, 1954)

Sept. 13–24, 1954
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Commercial Museum and Convention Hall, Philadelphia, Pa.
(Final date for submitting papers—May 1, 1954)

Sept. 26–29, 1954
ASME Petroleum—Mechanical-Engineering Conference, Statler Hotel, Los Angeles, Calif.
(Final date for submitting papers—May 1, 1954)
(For Meetings of Other Societies, see page 938)



ROWS OF LARGE-SIZE MACHINE TOOLS FROM SEVEN COUNTRIES ON EXHIBITION AT THE FIRST INTERNATIONAL MACHINE-TOOL EXPOSITION, BROOKLYN, N. Y.

Over 900 Attend ASME Petroleum Conference at Houston, Texas, Sept. 28–30

18 Sessions, 35 Papers, Industry Luncheons, Banquet, Toast-to-Texas Party Highlight "Best-Ever" Meeting

THE Eighth Petroleum Mechanical Engineering Conference, held in Houston, Texas, September 28–30, 1953, was noteworthy for its attendance by some 900 engineers from all sections of the United States and Canada. The meeting was sponsored by the Petroleum Division of the ASME with the wholehearted co-operation of the South Texas Section of the Society. Headquarters were at the Rice Hotel.

Eighteen Sessions

There were eighteen sessions at the meeting at which thirty-five papers were presented by outstanding men in their respective fields. The papers were divided into major catagories: refining, pipe lines, production and drilling, materials, and manufacturing. Of particular interest was the panel discussion on the ASME Unfired Pressure Vessel Code—a joint effort for safe construction. The detailed program of the meeting was published in MECHANICAL ENGINEERING for September, pages 750 to 751.

All of the papers were enthusiastically received, with an attendance running from 50 to 200 for each session. In many cases discussion waxed so enthusiastic that time ran out and individual discussions were continued where space could be found.

Welcoming Luncheon

One of the high spots of the meeting was the welcoming luncheon at which Frederick S. Blackall, jr., President of the ASME, was the speaker. He chose for his topic "The New Challenge to American Industry," in which he stressed the fact that it is only by constantly improving the tools of manufacturing processes that the United States is able to retain its position of industrial leadership in the world.

Mr. Blackall defended the position of the protective tariff and pointed out that while this country has been lowering its tariff rates, foreign countries have been raising their import rates and that actually we are no longer a high-tariff country as compared with others.

PRESIDENT BLACKALL, SPEAKER AT WELCOMING LUNCHEON

C. H. SCHUMAKER, VICE-PRESIDENT ASME, REGION VIII, AT WELCOMING LUNCHEON

The luncheon was held in the Crystal Ballroom of the Rice Hotel with R. B. Kinzbach, chairman of the South Texas Section of the ASME, and vice-president of the Kinzbach Tool Company, presiding. George Kesseler, mayor pro-tem of Houston, welcomed the delegates to the city. The introductions were made by L. S. Wrightsman, chairman of the Houston Arrangements Committee, with a response from C. H. Shumaker, vice-president of Region VIII of the ASME.

Five Special Industry Luncheons

On Tuesday and Wednesday, September 28 and 29, there were five special industry luncheons. They proved to be an opportunity to meet with others in a common field of interest as well as to get acquainted with the members of the working committee in the respective branches of the industry.

LIEUTENANT GENERAL E. O. THOMPSON, SPEAKER AT BANQUET

In commenting on these luncheons, Prof. E. N. Kemler, chairman of the ASME Petroleum Division, said they "were a huge success, with everyone helping to plan the next Division Conference with a splendid spirit of co-operation." Officers and committee members for the next year were selected.

Toast-to-Texas Party—Banquet

On Monday evening a dinner dance followed the Toast-to-Texas party, also held in the Crystal Ballroom. Entertainment at the dinner dance included an audience-participation show which proved to everyone's delight that engineers also shine in the field of music.

The Banquet was held on Wednesday evening with L. S. Wrightsman as presiding officer. The address of the evening was made by Lieutenant General Ernest O. Thompson, chairman of the Texas Railroad Commission. His subject, "Hemispheric Solidarity in Oil," was of great import to the more than three-hundred guests in attendance. He threw down the gauntlet to oil-importing companies, saying

"LARRY" WRIGHTSMAN, CHAIRMAN OF ARRANGEMENTS COMMITTEE AT BANQUET

that both Venezuela and Canada, members of the Interstate Oil Compact Commission, have programs for conserving oil and producing under conservation practices. The Middle East oil, on the other hand, is produced to the extent of the capacity of the wells and the ability of the producers to dispose of it.

He declared that importers must curtail their operations or the consequences to American oil producers and the industry generally will be disastrous.

Inspection Trips

Inspection trips for the meeting were ably handled and proved of interest to large numbers of those in attendance. The outstanding in interest was the Houston Ship Channel industrial area Boat Trip. Other trips of interest to many were to the A. O. Smith Corporation of Texas where the large-diameter-pipe-rolling mill was in operation; the Cameron Iron Works with its new plant, manufacturing electric-alloy steel, hammer and press forgings, and well-head equipment; the Hughes Tool Company with rock-bit and tool-joint shops and laboratories; the Texas Pipe Line Company where an inspection was made of the new semiautomatic crude-oil pump station and terminal; the Houston Pipe Line Company's modern vest-pocket gas-compressor station; the Humble Pipe Line Company with its modern semiautomatic products pipe-line pump station and terminal at Baytown; and the Shell Refinery where an inspection was made of the general plant layout and modern maintenance-shop facilities.

E. N. KEMLER, G. E. NEVILLE, O. L. LEWIS TALKING THINGS OVER AT PETROLEUM CLUB

Digests of Papers in This Issue

Digests of available papers presented at this Meeting are published in the ASME Technical Digest section of this issue on pages 919–923. A list of the papers with their numbers appears on pages 924-925.

Women's Program

Wives of ASME members attending the eighth Petroleum Mechanical Engineering Conference were entertained by a program of varied social activities.

The schedule for the two days included a conducted sight-seeing tour of the city, with visits to Rice Institute, Baylor University Medical School, University of Texas Medical Dental Branch, the Shamrock Hotel, and other places of interest. The tour was concluded with a luncheon held at the River Oaks Country Club.

Many of the women accompanied their husbands on the Port Commission Boat to view the Houston Ship Channel industrial area. This was one of several field inspection trips planned for ASME members.

Social events which included the women as guests were a "Toast-to-Texas" afternoon party at the Rice Hotel, followed by a dinner and dancing, and a "Sherry Party," at the Petroleum Club, Top-of-the-Rice, on Tuesday followed by the banquet.

The Ladies Activities Committee, assisted by wives of members of the South Texas Section, planned the entertainment. Members of the committee were: Mrs. L. S. Wrightsman, chairman; Mrs. M. I. Kearns; Mrs. R. B. Kinzbach; Mrs. Ralph Newhaus; Mrs. G. E. Nevill; and Mrs. R. L. Rowan.

This group received compliments for the completeness and variety of the women's program.

Also, many members noted that the efforts of Mr. and Mrs. L. S. Wrightsman (he was general chairman of the Houston Arrangements Committee) were responsible for the program's success, as evidenced by the large attendance recorded at both social and technical functions.

Production-Weighing Symposium Held at ASME-IRD Conference

A SYMPOSIUM on production weighing and control, sponsored by the Instruments and Regulators Division of ASME, was presented as a portion of the Eighth National Instrument Conference and Exhibit held in Chicago, Ill., September 21–25. More than 15,000 persons attended the conference.

Following the presentation of ASME-IRD papers on various phases of production weighing, a panel discussion was held. Topics covered various phases of production weighing, including high-speed weighing, continuous weighing meters and feeds, batch weighing, and electronic weight determination.

Contributing to the technical sessions of the conference, in co-operation with the National Instrument Society of America, were the Instrument and Measuring Committee of the American Institute of Electrical Engineers; the American Institute of Physics; the Industrial Instruments and Regulators Division of The American Society of Mechanical Engineers; the Professional Group on Instrumentation of the Institute of Radio Engineers; and the Scientific Apparatus Maker's Association.

The second Analytical Instrument Clinic, consisting of a lecture and demonstration course on complex analytical instruments, and covering electronic, optical, and mechanical-design applications, was a feature of the conference.

An Instrument Industry Luncheon was held for the instrument manufacturers, their wives, and representatives. This social event officially opened the Conference and Exhibit, at which was presented displays of the newest instruments and developments arranged by more than 200 instrument manufacturers.

The conference had as speakers more than 100 scientists and technical specialists who emphasized the varied contributions of industrial instrumentation to American production, indicating that future practices in American industry will continue to set the pace for the rest of the world.

A list of the IRD Conference papers appears on page 925 of this issue of MECHANICAL ENGINEERING. In addition, digests of available preprints of these conference papers are published in the ASME Technical Digest of this issue on pages 924-925.

MEMBERS OF THE PANEL DISCUSSION ON VARIOUS PHASES OF PRODUCTION WEIGHING AT THE ASME-IRD CONFERENCE, *left to right:* VERNE C. KENNEDY, JR., R. P. LOWE, J. J. HICKS, AND C. D CLOSE

ASME Standards Workshop

Interpretations of Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1–1951, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Case No. 13 is published herewith as interim actions of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

CASE NO. 13

Inquiry: What is the status of the "Report of Task Force on Flexibility, May 4, 1953" and Par. 620 in the 1951 Edition of the Code?

Reply: It is the opinion of the Committee that until a new edition of the Code is published revising Par. 620, any of the following procedures will meet the intent of the Code as it applies to piping flexibility.

(a) Follow the present wording of the Code, Par. 620.

(b) Follow the proposed revised wording given in the "Report of Task Force on Flexibility, May 4, 1953."

(c) Follow the proposed wording in the above Task Force Report, except using the alternate paragraphs contained in the report.

Survey On Engineering Salaries

CHEMICAL engineers, engineers holding executive-administrative positions, and those engaged in contracting work are the top money-makers of the engineering profession today, according to a salary and income survey conducted by a special committee of the National Society of Professional Engineers under the chairmanship of Ole Singstad, prominent New York engineer and world-famed designer of the Holland Tunnel.

In the salary statistics compiled according to the specialized branches of engineering, the median annual income of the chemical engineers was $8910; mining and metallurgical engineers, $8730; mechanical engineers, $8250; electrical engineers, $7940; and civil engineers, $7390. One of the reasons that civil engineers earn less, the committee reported, is that many of them work for government agencies, usually at the state or county level.

The median income for professional engineers holding executive-administrative positions was reported as $9930; median in sales work, $8370; in research and development, $7390; in design, $7160; and in production, $6960. When the engineers were classified by field of employment, the survey showed the median income of those working as contractors to be $9920; for private practitioners, $9690; for industry employees, $8420; and for education, $7590.

The survey indicated an over-all median figure of $7850. Ninety per cent of the engineers replying to the questionnaire earned at least $5120; twenty-five per cent, at least $10,980; and ten per cent, at least $17,190.

The survey covered the incomes for 1952 of more than 12,000 engineers of which 42 per cent were civil engineers, 27 per cent were mechanical engineers, and 18 per cent were electrical engineers.

The complete report has just been published in a 28-page booklet that includes detailed statistics and charts on geographic distribution, year of entry into the profession, types of employers, branches of the profession, type of work performed, earnings by years of experience, earnings according to grades, regional variations, and other data. It is available from the National Society of Professional Engineers, 1121 Fifteenth Street, N. Y., Washington 5, D. C., at $1 a copy.

In addition to Mr. Singstad, the other engineers who were members of the NSPE committee conducting the survey were: J. F. Hale, Dayton, Ohio; N. E. Hull, Houston, Texas; W. Austin Smith, Jacksonville, Fla.; C. E. Lawall, Huntington, W. Va.; K. K. Cooper, Fort Wayne, Ind.; and W. H. Hall, Durham, N. C.

Agenda Items for 1954 RAC Meeting

THE 1954 Agenda Committee has asked the sections to set up an Agenda Committee to expedite the collection, editing, and submission of agenda items. This Committee has been asked to canvass the membership for items and it is hoped you will support this effort one hundred per cent. The collection of these items and the invitation to the membership to submit them through their sections is a step in the democratic process by which the membership and the sections impart their ideas to the Council.

If you live within the boundary of a section and have not been approached, we suggest you submit your items to the secretary of your section. However, if you are outside the limits of a section, we suggest you address your items to the 1954 ASME Agenda Committee, 29 West 39th Street, New York 18, N. Y. Please study the wording of your proposed items to be sure they are clear and specific, and that there can be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "approve" or "reject" the item as worded.

The following is a suggested form we ask you to use in submitting items:

ASME AGENDA ITEM

PROPOSED BY.....of the.....Section

Date.....

Item: It is proposed that

Proposer's Comment:

.....
Signature

It is earnestly requested you submit your items immediately to make it possible to mail the first compilation of the agenda by the first of the year. The second compilation must be ready for distribution by March 15 at the latest, so as to reach sections in adequate time prior to the Regional Administrative Committee meetings. The tentative schedule is shown in the accompanying box.

Tentative Schedule 1954 RAC Meetings

Region	Place	Day	Date	Meeting Place
I	Storrs, Conn.	Saturday	May 1st	Univ. of Conn.*
II	New York, N. Y.	Mon.-Tues.	May 3–4	Headquarters
III	Buffalo, N. Y.	Wednesday	April 7	Statler
IV	Knoxville, Tenn.	Sunday	March 28	Univ. of Tenn.**
V	Cleveland, Ohio	Mon.-Tues.	April 5–6	Wade Park Manor
VI	Milwaukee, Wis.	Fri.-Sat.	April 9–10	Schroeder
VII	Portland, Ore.	Fri.-Sat.	April 16–17	Mallory
VIII	Tulsa, Okla.	Sunday	April 25	Mayo

* Delegates will be housed at Hotel Nathan Hale, Willimantic, Conn.
** Delegates will be housed at Hotel Andrew Johnson, Knoxville, Tenn.

New ASME Officers Elected by Letter Ballot

AS reported by the tellers of election, 1954 officers, Harold V. Coes, William G. Christy, and H. B. Oatley, letter ballots received from members of The American Society of Mechanical Engineers were counted on Sept. 22, 1953. The total number of ballots cast was 11,482; of these 214 were thrown out as defective.

	Votes for	*Votes against*
For President		
Lewis Ketcham Sillcox	11,254	14
For Regional Vice-Presidents —serve two years		
Willis Frederick Thompson	11,251	17
William George McLean	11,254	14
Thompson Chandler	11,257	11
Vernon A. Peterson	11,246	22
For Regional Vice-President—serve one year		
Clifford H. Shumaker	11,253	15
For Directors at Large—serve four years		
Frank Leo Bradley	11,259	9
Robert Brook Lea	11,256	12

The new officers will be introduced and installed in office during the 1953 Annual Meeting of the Society to be held at the Hotel Statler, New York, N. Y., Nov. 29–Dec. 4, 1953.

Biographical sketches of the newly elected officers were published in the September issue of MECHANICAL ENGINEERING, pages 754–757.

Coming Meetings

Scientific Editorial Problems

THE second Conference on Scientific Editorial Problems will be held Dec. 27, 1953, at Boston, Mass., during the annual meeting of the American Association for the Advancement of Science. This meeting will be open to all interested persons.

The Conference, organized in 1952, has as its purpose: To bring before the American Association for the Advancement of Science some of the important problems that confront those who prepare scientific manuscripts, who are concerned with the preparation of technical reports, or who edit and produce scientific publications.

Gasification of Coal

AN International Conference on Complete Gasification of Coal will be held at Liège, Belgium, May 3–8, 1954, to study methods of gasification of mined coal. Various processes are at present being studied, or have reached the semi-industrial scale, and in some cases, industrial application has been achieved. Several types of processes will be necessary because of the number of factors involved, such as the nature of the fuel, the scale of production, the quality of the gas required, and so on.

The text of reports to be given at the Conference should be sent to Inichar before Jan. 1, 1954. They will be reproduced in three languages, French, English, and German, and will be sent to those taking part, before the Conference. For further information, a descriptive bulletin, and circular, write to Inichar, 7 Boulevard Frère-Orban, Liège, Belgium.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York, 8 West 40th Street | Chicago, 84 East Randolph Street | Detroit, 100 Farnsworth Ave. | San Francisco, 57 Post Street

Men Available[1]

Executive Engineer, 51, mechanical graduate, desires connection with medium-sized company, assume full responsibility as production manager, chief engineer, staff assistant. Twenty-five years' design, manufacturing, sales experience. Specialist in manufacturing of automatic machinery, instruments, tools, etc. Familiar engineering, developing new products, purchasing, assembly, inspection. Me-11.

Industrial Engineer, 29, shop background, BSE, married, five years' experience, including supervision, in standards, cost reduction, procedures, budgetary controls, cost estimating, layout and performance reports in aircraft and automobile manufacturing. Will relocate. Me-12.

Mechanical Engineer, BE, Yale, 31, married, six years' manufacturing and new factory establishment experience abroad, desires consulting or manufacturing work in Canada. Good background in all phases of new plant layout, production, general engineering, labor relations, quality and purchasing problems. Me-13.

Mechanical Engineer, 45, married, broad experience application, sales, management, desires position supervision or sales abroad, or assistant to executive. Eight years' domestic, 12 years' foreign experience. Me-14.

Mechanical Engineer, PE, graduate, 15 years' experience in marine and utility-power plants. Design, specifications, instrumentation, steam generators, pressure vessels, etc. Seeks position as staff engineer. New York metropolitan area. Me-15.

Engineer, MS in Engineering, LLB, registered PE, 38, 11 years' teaching. Presently in industry as power consultant. Desires professorship in mechanical engineering or responsible position with administrative duties. Me-16.

Mechanical-Executive Engineer, 38, MME, PE, N. Y. and N. J. Sixteen years' diversified experience product design, development, manufacture electromechanical, hydraulic, precision, servo power drives, gravure presses, special machinery; plant engineering, operation; estimating, contracting. Chief engineer of multi-plant firm with management and administrative experience. Prefers New York metropolitan area. Me-17.

Mechanical Engineer, 28, married, BSME, eight months' experience design of heavy trucks, eight months' experience as diesel mechanic, South America. Me-18-539-D-12.

Industrial Engineer, 32, BSIE, graduate of Harvard Business School; six years' experience industrial engineering and production management. Desires responsible position in industrial engineering or production supervision. East or West Coast. Me-19.

Chief Engineer, 34, married, 15 years' experience in design, sales, and fabrication of heat exchangers, pressure vessels, and heavy industrial equipment. Considerable field experience in erection and operation of above equipment. Me-20.

Mechanical Engineer, 45, married, MME, 20 years' experience application engineering, sales, management. Power-plant equipment, appliances, refrigeration, air conditioning. Had responsible positions 14 years in foreign field. Desires permanent desk or field position. West Coast, New York, N. Y., Foreign. Me-21-539-D-1.

Mechanical Engineer, 30, BS, married, executive potential, desires change from present design work to position, with a future, requiring more initiative and capability. Experience in export, business, and investment. Me-22.

Engineer, 33, PE, plant engineering, preventive maintenance, machine shop, methods, standards, cost control, estimating, handling. Line and staff. Desires administrative responsibility. Small or medium-size company. Consider other. Prefers South. Me-23.

Materials-Handling Engineer and Methods Analyst, 30, MME, PE; desires position involving mass distribution and/or manufacturing problems; six years' experience food industry including conveying systems and industrial-truck methods applications. Prefers metropolitan New York area. Me-24.

Production Engineer, BME, 29, married. Three years' experience in metal-parts manufacturing, three years in design. Desires challenging position. Capable of administrative as well as technical effort. New York metropolitan area. Me-25.

Mechanical Engineer, 29, BSME, three years' experience design and development gas turbines; four years' experience power-plant design, economic reports. Desires position in related field. New York metropolitan area. Me-26.

Positions Available

Assistant Professor or Instructor, young, to teach thermodynamics, aeronautics, heating and ventilating, and probably some mechanics in the mechanical-engineering department. Rank and salary dependent on qualifications. Liberal policy in granting leave of absences on half salary to qualified instructors who wish to do graduate work. Position starts February, 1954. East. Y-8749.

Mechanical Engineer (project engineer), responsible for the operation and modifications to the cyclotron. Design of all mechanical and electromechanical parts and modifications. Design of all experimental equipment. Knowledge of special materials and fabrication techniques. Will take charge of precision-shop and maintenance crew. Shop constructs all cyclotron modifications and most of the experimental equipment. Salary open. N. Y. State. Y-9138(*a*).

Director of Engineering, over 38, for an engineering service company. Must be licensed in Ohio or qualified to secure license. Prefer me-

[1] All men listed hold some form of ASME membership.

chanical-engineering graduate. Must have had experience in design and development work, preferably on a varied line of equipment; also some administrative experience. Will supervise large design group, consult with customers, etc. Salary open. Ohio. Y-9139.

Manufacturing Assistant, 35–40, graduate, degree in engineering and broad and diversified production experience in a processed-type industry, preferably foods, in addition to a thorough knowledge gained through experience of industrial engineering, facilities engineering, design and construction, and maintenance engineering. Experience in both line and staff capacity preferred. Will assist director of manufacturing and engineering, consulting on all matters pertaining to manufacturing and engineering, keeping the director informed on conditions, plans, and developments in connection with these operations. $18,000. Moderate to heavy traveling. Headquarters, New York, N.Y. Y-9146.

Mechanical Engineer, 35–40, graduate, at least 10 years' power and process-plant engineering experience, for supervision of equipment engineering, installation, and operation. $8000–$15,000, plus quarters, light, etc. Cuba. F-9150.

Engineer to supervise maintenance and repair work in three raw-sugar factories located in Cuba. Permanent residence in Cuba required, and knowledge of Spanish important. About $10,000. Housing provided. F-9152.

Development Engineer, mechanical, under 40, to work with a four-man team on an advanced engineering project having to do with the development of new or radically changed laminated and insulating products through the use of new materials, new processes, and new equipment. $8500. Ohio. Y-9155.

Chief Engineer, mechanical graduate, 40–50, six to 10 years' experience on cold cup paper-machine design. This experience necessary. Company will pay moving expenses and placement fee. $10,000. Midwest. Y-9157.

Executive Engineer, 40–45, mechanical-engineering graduate, with managerial experience in packaged air-conditioning and refrigeration fields. $10,000–$12,000, plus bonus. Northern N. J. Y-9189.

Engineers. (*a*) Designer, experienced in design of office machinery such as adding machines, typewriters, calculators, tabulators, etc. Design problems requiring use of stampings, castings, plastic moldings, with emphasis on simplicity and low cost. Will prepare own scale layouts and will be furnished assistance for detailing. About $7500. (*b*) Designer, experienced in design of paper-handling equipment such as printing presses, collating machines, and automatic production machinery in general. Will prepare own scale layouts and be furnished assistance for detailing. About $7500. Ohio. Y-9215.

Design Engineers, mechanical and electrical, little drafting-board work, for fractional hp induction motors, mechanical mechanisms, control elements, small high-speed air, steam, and combustion turbines, heat-transfer design associated with motors and generators, hydraulic and pneumatic controls. $5700–$7800. Ohio. Y-9216.

Design or Development Engineers for production measuring instruments. Must be college trained although degree is unimportant. Should preferably have experience, not necessarily in the instrument field, but design or development experience on mechanisms, electromechanical devices, etc. Product design would be useful. Salary open. Pa. Y-9223.

Design and Development Engineers, preferably mechanical graduates, for design and development of new products. Will be required to do some drafting and supervise production. Company manufactures miniature record players. $3600–$4200, to start. New York, N. Y. Y-9224.

Engineers. (*a*) Research engineers, not over 35, BS, MS, or PhD in mechanical engineering, applied mechanics, applied math, chemical physics or engineering physics. $4200–$6300. (*b*) Safety engineer, not over 35, BS or MS in mechanical engineering, up to three years' experience in research or safety work. Will direct the safety program of a research organization engaged in the field of rockets and solid propellants. $4200, to start. Ala. Y-9227.

Field-Sales Engineer, 30–40, mechanical or electrical graduate, electrical background for a medium-sized manufacturer of tools and equipment used in the installation of electrical circuits and sold through a nationwide organization of manufacturer's representatives. Extensive traveling throughout U. S. working with representatives and their customers. Headquarters, Pa. Y-9228.

Sales, Engineer, 30–40, mechanical graduate, sales and operating experience in steam-power generating plants, to sell glass products to steam-power plant accessories manufacturers. Some traveling. $6000–$8000. N. Y. State. Y-9243.

Junior Mechanical or Industrial Engineering Graduate, interested in the packaging field. Will assist chief packaging engineer in the design and development of packages and labels to support merchandising programs. $4800–$6000. Mich. D-8864.

Refrigeration Engineer—Development, 25–45, at least one year's experience in commercial refrigeration or air conditioning, particularly units. Will take charge of design and development of annual models of refrigeration units for buses, cars, etc. for a manufacturer. $6000. Employer will pay placement fee. Some traveling. Ill. C-1299.

Design and Development Engineers, mechanical or electrical, 25–35, at least one year's experience in design of appliances or electronic equipment. Knowledge of metals, plastics, and rubber. Will supervise small machine shop in laboratory making pilot models of speakers for a manufacturer of speakers. $5500–$8000. Employer will pay placement fee. Ill. C-1300(*b*).

Hydraulics Designer, up to 45, at least two years' experience in designing, piping, or grey iron castings for drainage equipment. Knowledge of fluid dynamics and pressure vessels. Duties include determination of pattern changes, development of new products, supervise production and engineering of water-hammer arrestors for a plumbing manufacturer. $5000–$10,000. Employer will pay placement fee. Ill. C-1308.

Engineers. (*a*) Project engineer, mechanical or electrical, three years' experience in project on automotive or aircraft instruments or other small devices. Knowledge of machine-shop operations. Will put gages and instruments into production after they have been developed for a manufacturer. $7500. Employer will pay fee. (*b*) Design engineer—research, mechanical, at least two years' experience in design and development of fluid flowmeters with automatic shutoff valves. $7500. Employer will pay fee. Ill. C-1309.

Manufacturing Engineer, up to 70, five years' experience in processing and manufacturing drilling equipment and tools for well-drilling rigs. Knowledge of deep water wells helpful. Will serve as consultant on improving manufacture and maintenance of well-drilling tools. Will have to train workers, skilled and professional, in methods. One year contract; 25 per cent overseas bonus and $250 a month cost-of-living allowance. Can take family. $12,000. India. C-1310.

Plant Engineer, BSME, 28–35, experienced in maintenance, construction, or plant engineering. Knowledge of heat transfer. Duties include maintenance, construction, steam generation, spare parts, and stockroom for a manufacturer of fine chemicals. $4800–$6000. Mich. C-1315.

Chief Engineer, to 40, mechanical graduate, background in plant-maintenance engineering and administration. Supervisory experience essential. Able to plan and direct activities of 60 men, including five engineers, air-conditioning experts, machinists, maintenance men. Responsible for over-all direction of factory-engineering division, including maintenance, personnel, machine shop of 30–40 machinists, powerhouse, and air-conditioning machinery. $10,000, plus bonus. Ky. C-1324.

Design Engineer, 30–40, mechanical or electrical degree, several years' experience in instrumentation or electrical controls. Will do development and design work on mechanical portion of indicating and recording controllers and miscellaneous electrical-control devices. Salary open. Ill. C-1327.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Nov. 25, 1953, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt & Reinstatement; Rt & T = Reinstatement and Transfer to Member

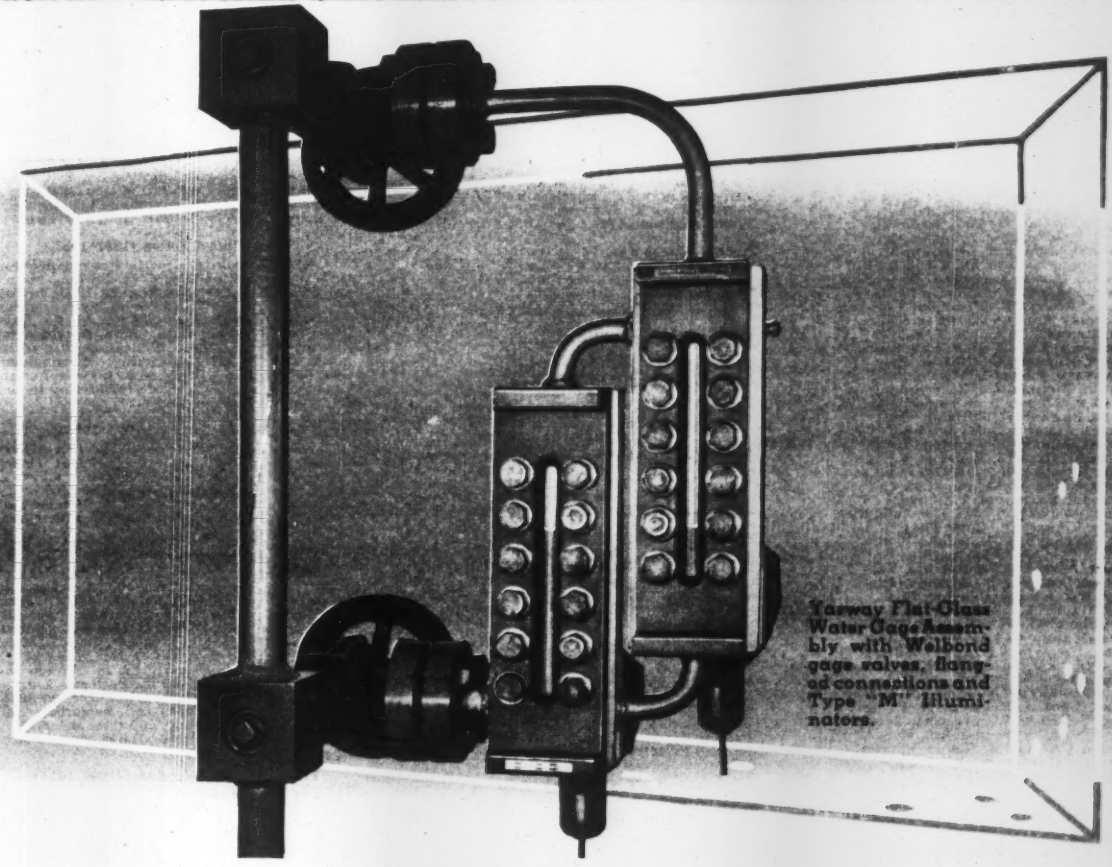
NEW APPLICATIONS

For Member, Associate, or Junior

ALDRED, WENDELL C., Wilmington, Del.
ALT, ALVIN F., Cincinnati, Ohio
ANDERSON, DELWYN W., Honolulu, T. H.
APHTHORP, CARL R., JR., Shaker Heights, Ohio
ARNOLD, ANTHONY P., Wyomissing, Pa.
ATHERTON, JAMES R., Honolulu, T.H.
BACKLUND, JOHN R., Bloomington, Ill.
BAKER, GEORGE L., Ewa, Hawaii, T. H.
BARNARD, HAWLEY N., Ann Arbor, Mich.
BARR, SAMUEL D., New York, N. Y.
BARTER, LYLE D., Honolulu, T. H.
BAXTER, DONALD C., Ottawa, Ont., Can.
BIRNIE, CLOTWORTHY, JR., State College, Pa.
BLAKE, WALTER R., Honolulu, T. H.
BOGHOSIAN, SOUREN K., San Francisco, Calif.
BOISE, DAVID R., Amarillo, Texas
BOLLES, ELMER R., Honolulu, T. H.
BOYLE, MONTROSE L., Havertown, Pa.
BRADNER, MEAD, Foxboro, Mass.
BREWSTER, CECIL W., London, England
BROWN, GROVER D., Los Angeles, Calif.
BROWN, ROGER J., Bloomfield, Conn.
BURROWS, HARRY T., Honolulu, T. H.
BURT, GEORGE H., Chicago, Ill.
BURTON, WILLIAM T., Honolulu, T. H.
CAIN, JAMES A., Chattanooga, Tenn.
CALMES, JOHN P., Lake Jackson, Texas
CAMPBELL, MATTHEW T., San Francisco, Calif.
CHUN-MING, WILLIAM, Honolulu, T. H.
CLARKE, THOMAS H., San Mateo, Calif.
CONRADSEN, PAUL C., St. Marys, Ont., Can.
COOPER, EDWARD B., San Francosco, Calif.
CORLETT, ROBERT J., Kaneohe, Oahu, T. H.
CORYELL, GLYNN L., Arlington, Va.
CRAIG, JOHN C., Honolulu, T. H.
CUMMINGS, KENNETH, Baltimore, Md.
CUNNINGHAM, ELIJAH P., St. Louis, Mo.
CURRIER, DONALD C., Mishawaka, Ind.
DAWIDOWICZ, JAN, Woonsocket, R. I.
DAVIS, JAMES H., Honolulu, T. H.
DEL CURO, JAMES F., San Francisco, Calif.
DINGLER, RICHARD P., Michigan City, Ind.
DURANT, CHADWICK W., Honolulu, T. H.
DURANT, ELBRIDGE A., Honolulu, T. H.
ECKLUND, WILLIAM A., San Francisco, Calif.
ETHAN, ZACKI, Los Angeles, Calif.
FANGEMANN, MELVIN G., Brooklyn, N. Y.
FARMER, JOHN, Lanikai, Oahu, T. H.
FOGWELL, JOSEPH W., San Antonio, Texas
FORD, JOHN R., San Francisco, Calif.
GARRATT, MANSFIELD W., SR., San Francisco, Calif.
GILL, SIDNEY S., Monroe, La.
GILLARD, THOMAS J., Tullahoma, Tenn.
GOOD, CHARLES H., Ypsilanti, Mich.
GOTHERMAN, WILLIAM W., Charlotte, N. C.
GRAY, PERCY S., Honolulu, T. H.
GRIFFITH, P. LEROY, New York, N. Y.
GRUBER, CHARLES W., Cincinnati, Ohio
HALLETT, SAMUEL G., JR., Milltown, N. J.
HALLMAN, CHARLES, Cleveland, Ohio
HAMILTON, ROBERT E., Honolulu, T. H.
HANSKUTT, DOA C., Knoxville, Tenn.
HARANG, RICHARD A., Ridgewood, N. J.
HARPER, OSCAR C., JR., Altadena, Calif.
HASPELMATH, CHARLES E., Schenectady, N. Y.
HAYS, JOHN B., Shreveport, La.
HEBERT, ATLAS J., Honolulu, T. H.
HENDRICKSON, EDWIN A., Honolulu, T. H.
HERSCHER, GEORGE S., Charleston, W. Va.
HICKS, FRANK R., Honolulu, T. H.
HOCHREITER, HARRY M., JR., Hatboro, Pa.
HOEBEL, CHARLES L., New York, N. Y.
HOLMAN, EARL L., Lanikai, T. H.
HONG, PAUL L., Aiea Oahu, T. H.
HORN, HAROLD, Franklin Square, L. I., N. Y.
HULL, WILLIAM J., Honolulu, T. H.
IMADA, JAMES H., Honolulu, T. H.
IZKICKI, JOHN J., Worcester, Mass.
JAY, JOE MING, Honolulu, T. H.
JENSEN, JORGEN P., Honolulu, T. H.
JOHNSON, LLOYD H., Scotia, N. Y.
JOHNSON, WILLIAM N., Pittsburgh, Pa.
JOHNSTON, WALLACE D., Honolulu, T. H.
JUNGE, ROBERT D., Tracy, Calif.
KARR, FRANCIS E., Lanikai, Oahu, T. H.
KELLOGG, L. ANDREW, Syracuse, N. Y.
KENDALL, LYLE H., New Orleans, La.
KINDLER, FRITZ, Staten Island, N. Y.
KNAPP, DAVID B., Kaneohe, Oahu, T. H.
KNOX, CLIFFORD, Honolulu, T. H.
KNOX, HAROLD I., York, Pa.
LAMKIN, LESSEL E., Albuquerque, N. Mex.
LEAO, MANDEL L., Porto Alegre, Brazil
LETANOSKY, LOUIS A., Bessemer, Ala.
LEVINSON, NORMAN J., Chicago, Ill.
LIDDELL, ROBERT, Honolulu, T. H.

(*ASME News continued on page 946*)

What's New
IN BOILER WATER LEVEL INDICATION?



Yarway Flat-Glass Water Gage Assembly with Welbond gage valves, flanged connections and Type "M" Illuminators.

NEW *SEPARATED-DESIGN* WATER GAGES

This new Yarway water gage assembly has been developed to meet the demands for greater dependability, longer life, and more accurate readings in high pressure service.

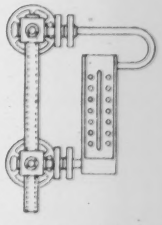
The gage glass inserts are of the Yarway pressure-sealed "floating assembly type". Yarway Welbond gage valves are used. Greater flexibility is gained by using two independent inserts, and by interconnecting expansion loops (see above).

The short connection to the drum assures greater accuracy of the gage reading, and the lower flanged connection eliminates a stuffing box. The upper flanged loop connection between the insert and gage valve allows expansion and contraction of the various components.

The tie bar-type water column linking the gage valves provides circulation to keep gage nearer drum temperature.

Yarway Type "M" Illuminators on the gage inserts cause the meniscus at water level to "shine like a star". This illuminator is especially effective in penetrating deposits on gage glass, dust particles in air and extraneous light.

For full information, write for Yarway Bulletin WG-1811.



Yarway Single Insert type gage for medium range of visibilities.

YARNALL-WARING COMPANY • 108 Mermaid Avenue, Philadelphia 18, Pa.

Branch Offices in Principal Cities

YARWAY **STEAM PLANT EQUIPMENT**

LINDSEY, LAWRENCE D., Tullahoma, Tenn.
LIVINGSTON, HART L., Orinda, Calif.
LOCHMILLER, WALTER R., Lanikai, T. H.
LOEW, PETER F., Chicago, Ill.
LOVICK, JOHN B., Sun Valley, Calif.
LUBIN, JOHN F., Philadelphia, Pa.
LUMLY, THOMAS M., Tulsa, Okla.
LYDIARD, WALTER B., Auckland, New Zealand
LYLE, JAMES E., JR., Chattanooga, Tenn.
MACHACEK, RUDOLPH J., Chattanooga, Tenn.
MACK, CHESTER F., Seattle, Wash.
MACKENZIE, JOHN M., St. Louis Park, Minn.
MAGAR, NASRI D., Los Angeles, Calif.
MAHONY, JOHN W., Honolulu, T. H.
MARQUISS, RALPH E., Baltimore, Md.
MARTIN, CHARLES M., Oakland, Calif.
MAYER, GLENN, E., Spokane, Wash.
MATSUMOTO, EIJI, Osaka, Japan
MCCLERRY, WALTER L., JR., Ewa, Hawaii, T. H.
MCDONALD, JOHN O., Freehold, N. J.
MCKINNEY, WILLIAM J., Atlanta, Ga.
MEINECKE, JOSEPH B., Honolulu, T. H.
MELLOR, ALFRED G., Scotia, N. Y.
MESERVE, JULIAN H., Saginaw, Mich.
MILLER, PAUL R., San Francico, Calif.
MITCHELL, MELVIN R., Saginaw, Mich.
MONTGOMERY, ELMER M., Chicago, Ill.
MORDELL, DANIEL J., Buffalo, N. Y.
MORROW, JOSEPH F., Moorestown, N. J.
MULLEN, ROBERT L., Honolulu, T. H.
MUSSELMAN, LYTTON C., Sierra Madre, Calif.
NASH, HENRY R., Lanikai, T. H.
NICKOLADZE, LEO G., Honolulu, T. H.
NOONAN, NORBERT G., Denver, Colo.
OSTERGAARD, PALLE C., Pittsburgh, Pa.
PENROSE, RICHARD L., Glenn Riddle, Pa.
PETRASEK, ROBERT F., Richmond, Va.
PETRUS, EDWARD F., Burbank, Calif.
PHILLIPS, ALBERT C., Miami, Fla.
PHILLIPS, ROBERT J., Houston, Texas
PILACINSKI, GEORGE, Norwood, Pa.
POCHE, JOHN A., JR., New Orleans, La.
RAYBURN, LEO, Wollaston, Mass.
RICHMOND, NATHANIEL T., Camden, S. C.
RIDDICK, WILLARD J., JR., Honolulu, T. H.
RIEGER, ROBERT W., Carle Place, L. I., N. Y.
ROOK, HERBERT H., Honolulu, T. H.
SARSTEN, JAN A., Richmond, Va.
SHAMAH, ALFRED A., Alexandria, Va.
SHOOPAK, BERNARD F., Schenectady, N. Y.
SHORT, KEITH I., Washington, D. C.
SIMMS, HARRY A., Lanikai, T. H.
SIRA, ADRIAN G., Pearl Harbor, T. H.
SIRKIN, MAURICE F., Fitchburg, Mass.
SLATER, HORATIO N., JR., Far Hills, N. J.
SOCHACZEWSKI, ZDZISLAW W., Earley, Berks, England
SOSA, FERDINAND, New York, N. Y.
STEVEN, GEORGE, Kenmore, N. Y.
STOVALL, SAMUEL W., Freeport, Texas
SUHR, J. ROBERT, Pennsauken, N. J.
SVOBODA, CHARLES R., Kansas City, Mo.
SWERDLIN, MANNEY, Honolulu, T. H.
TERRY, EDWARD D., Olaa, T. H.
THOMAS, GOODWIN G., Rock Hill, S. C.
TOLLAR, JAMES E., Midland, Mich.
TOMOLONIUS, WILLIAM A., Worcester, Mass.
TURNER, JACK R., Detroit, Mich.
TUTZAUER, WILLIAM A., Honolulu, T. H.
VAHS, WILLIAM A., Hamilton, Ont., Can.
VICKERS, LEO J., Palo Alto, Calif.
WANGENHEIM, HERBERT L., Honolulu, T. H.
WATSON, WILLIAM S., Lanikai, Oahu, T. H.
WATT, RONALD G., Honolulu, T. H.
WEBER, WILLETT F., Chicago, Ill.
WRIGLE, JOSEPH V., Closter, N. J.
WEMPE, MARTIN H., San Francisco, Calif.
WHEELER, DEAN F., Ann Arbor, Mich.
WILLIAMSON, ARTHUR, Honolulu, T. H.
WOLFENSPERGER, ADOLPH, Oakland, Calif.
WONG, KAI FONG, Wahiawa, Oahu, T. H.
WOODELL, CHARLES L., Charleston, W. Va.
WURTH, WERNER H., Independence, Mo.
WYNN, ROBERT O., Houston, Texas
YAMANE, JAMES H., SR., Honolulu, T. H.
YATES, THOMAS B., JR., New York, N. Y.
ZARWYN, BERTHOLD, New York, N. Y.
ZAYOTTI, HENRY R., Wayland, Mass.
ZEIGLER, JESSE R., Honolulu, T. H.
ZLOE, EDWARD D., Cresskill, N. J.

CHANGE IN GRADING

Transfer to Member and Associate

BLACKALL, FREDERICK S., 3RD, Cumberland Hill, R. I.
BLOCK, KENNETH L., Chicago, Ill.
BOUSHELL, CLINTON C., E. Stroudsburg, Pa.
BROWN, HOYT W., JR., Birmingham, Ala.
CORDES, FRED K., Honolulu, T. H.
DICKINSON, DON M., Ballston Lake, N. Y.
DIMITRI, PETER, New York, N. Y.
DODGE, WILBUR W., Peoria, Ill.
EDWARDS, JAMES L., Clemson, S. C.
FELIX, SAMUEL P., San Francisco, Calif.
FREED, DEAN W., Cleveland, Ohio
GILMORE, CHARLES G., Meadville, Pa.
GRUNDBERG, CURTIS A., Coatesville, Pa.
GUGGENHEIM, S. FREDERIC, Teaneck, N. J.
HAMBLEN, HAROLD C., Massapequa, L. I., N. Y.
HANZALEK, WILLIAM V., Woodridge, N. J.
HENDRIX, JACK W., Huntsville, Ala.
HOLMES, ALVIN C., Milwaukee, Wis.
HOWARTH, ELBERT S., New Kensington, Pa.
HUGHES, ELMER L., JR., Kansas City, Mo.
JOHNSON, KARL E., Kansas City, Mo.
JONES, JAMES B., Lafayette, Ind.
KAYS, WILLIAM M., Stanford University, Calif.
KECECIOGLU, DIMITRI B., West Allis, Wis.
KENT, GEORGE C., Chicago, Ill.
MAHLAB, SALIM S., Wilmington, Del.
MARTEL, MAX R., East Moline, Ill.
MCDONALD, JOSEPH J., Paducah, Ky.
MCINTOSH, CLAUDE B., Cleveland Heights, Ohio
MENGEL, WALTER A., Rumford, R. I.
MOGLIA, GUIDO A., Albertson, N. Y.
NAULIN, DONALD B., Chicago, Ill.
NOVAK, HOWARD M., Rochester, N. Y.
PETRUZZO, ALBIE R., Stoughton, Mass.
SCHADE, ALBERT, 3RD, Fort Washington, Pa.
SISLER, CHARLES W., St. Louis, Mo.
SMITH, ANDREW N., Schenectady, N. Y.
SMITH, FRANK F., Edmonton, Alberta, Can.
SVENSON, ROBERT H., JR., Bogotá, Colombia, S. A.
SWET, WILLIAM L., Ft. Wayne, Ind.
VOGELSBERG, ROBERT W., Avondale Estates, Ga.
WILSON, NORMAN A., Westboro, Mass.
WORLEY, WILL J., Urbana, Ill.

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Obituaries

George Lewis Bennett (1875–1953)

GEORGE L. BENNETT, civil engineer, who helped design portions of New York City's reservoir system, was found dead in his home at New Milford, Conn., Aug. 11, 1953. According to the medical examiner, death occurred about Aug. 6, 1953. Mr. Bennett, who was 70 years old, had resided alone since his wife's death in 1949. Born, Brooklyn, N. Y., Feb. 5, 1875. Education, CE, Columbia University School of Mines, 1898. During World War I he served with the Hoover Commission for conservation of food resources and in World War II he served in various places as an engineer in the designing of master dies for armament production. Mem. ASME, 1905.

Robert Grant Bohn (1892–1952)

ROBERT G. BOHN, chief engineer, executive-director of engineering, Michigan Carton Co., Battle Creek, Mich., died Nov. 21, 1952, according to a notice recently received by the Society. Born, Grand Island, Neb., March 31, 1892. Parents, Henry and Minnie Martha (Grant) Bohn. Education, Colorado School of Mines; BS, Armour Institute, 1914. Married Helen M. Jarvis, 1916; children, Elizabeth J., Martha A., Margaret D. Jun. ASME, 1916; Assoc-Mem. ASME, 1924; Mem. ASME, 1928. He held several patents on industrial control and process devices for board-mill operation.

Arthur Robert Borden (1899–1953)

ARTHUR R. BORDEN, manager of the Detroit branch office of Hagan Corp., Pittsburgh, Pa., died at his home in Detroit, Mich., July 6, 1953. Born, Wellsboro, Pa., Aug. 1, 1899. Parents, Robert W. and Eva (Sperry) Borden. Education, BS(ME), Pennsylvania State College, 1922. Married Gertrude P. Ormiston, 1928. Assoc-Mem. ASME, 1931; Mem. ASME, 1935. Survived by his wife; a son, Arthur R., Jr.; a daughter, Louanne; an uncle, Carlos E. Sperry.

Richard Bowcock (1913–1953)

RICHARD BOWCOCK, mechanical engineer, Howard Smith Paper Mills, Ltd., Cornwall, Ont., Can., died July 26, 1953. Born, Thorold, Ont., June 10, 1913. Education, BS(ME), Sheffield (England) Polytechnic Institute, 1934. Mem. ASME, 1949.

Paul Henry Buxton (1894–1953)

PAUL H. BUXTON, plant engineer, Olin Industries, Inc., Alton, Ill., died May 23, 1953. Born Boston, Mass., March 28, 1894. Parents, Charles H. and Idella Buxton. Education, BS, Massachusetts Institute of Technology, 1916. Married Ruth Cummings, 1920. He held U. S. Patents on the manufacture of steel ammunition cases and a control for trap-shooting apparatus. Mem. ASME, 1931; Fellow ASME, 1945. Survived by his wife, a son and daughter, and two grandsons.

Griswold Denison (1882–1953)

GRISWOLD DENISON, project engineer, Baker & Spencer, Inc., New York, N. Y., died April 11, 1953. Born Brooklyn, N. Y., July 11, 1882. Parents, Charles H. and Marie (Rogers) Denison. Education, ME, Columbia University, 1904. Married Berna Pohlman (died 1945). Mem. ASME, 1918. Survived by daughter, Catherine B.; by his mother and two sisters, Mrs. Rachel Grant and Mrs. Robert W. Milbank.

George Blaine Ebersole (1892–1953)

GEORGE B. EBERSOLE, project manager, Sales Division, The Babcock & Wilcox Co., New York, N. Y., died April 3, 1953. Born, Detroit, Mich., July 31, 1892. Parents, William P. and Hannah Ebersole. Education, high-school graduate; attended Columbia University. Married Mabel G. O'Neal. He held U. S. Patents on pulverized coal systems and pulverizers for coal and miscellaneous materials. Mem. ASME, 1949. Survived by wife and four children, Mrs. James J. McCorts, Mrs. William Hopkins, Mrs. Otto Altenburg, and George O'Neal Ebersole.

John Francis Fayman (1930–1953)

JOHN F. FAYMAN, lieutenant, U.S.A.F., was killed in Korea, July 27, 1953. Born, Baltimore, Md., May 29, 1930. Education, attended Baltimore Polytechnic Institute, 1944–1948; BS(ME), University of Maryland, 1951. Jun. ASME, 1951.

George William Felton (1881–1953)

GEORGE W. FELTON, a production engineer for the War Production Board in Boston, Mass., during World War II, died Aug. 23, 1953, Faxton Hospital, Utica, N. Y. Prior to his retirement four years ago, he was an engineer for the Raytheon Corp., Newton, Mass. Born, Birmingham, England, April 16, 1881. Education, 2½ years, Mason College of Engineering, Birmingham. Mem. ASME, 1921. Survived by his wife, Louise, and two daughters Mrs. Frederick McGowan and Mrs. Seymour Wheelock.

Carl William Grimm (1905–1953?)

CARL W. GRIMM, whose death was recently reported to the Society, was vice-president, Henry Pratt Co., Inc., Chicago, Ill. Born, Chicago, June 29, 1905. Education, BS(ME) University of Michigan, 1928. He held U. S. Patents pertaining to paper-mill and paper-products machinery. Mem. ASME, 1948.

Arthur Archibald Hadden (1888–1952)

ARTHUR A. HADDEN, since 1944 president of McClure, Hadden & Ortman, Inc., Chicago, Ill., engineering firm, died Aug. 16, 1953. Born, Minneapolis, Minn., Feb. 2, 1888. Parents, Archibald and Sarah (Bean) Hadden. Education, BS, Dartmouth College, 1909. Mem. ASME, 1934. In 1945 he was named one of ten outstanding industrial engineers in Chicago and in 1952 he was named to the national board of directors of the Methods Time Measurement Association for Standards and Research. Survived by his wife, Martha; and three sisters, Mrs. Jean Reynolds, Mrs. Helen Harkness, and Miss Elizabeth Hadden.

Frank William Herrmann (1899–1953)

FRANK W. HERRMANN, design engineer of special machinery, Metropolitan Device Corp., Brooklyn, N. Y., died Aug. 8, 1953. Born, New York, N. Y., April 5, 1899. Education, certificate in mechanical technology, Pratt Institute, 1945. Mem. ASME, 1948.

MacLean Houston (1892–1952)

MACLEAN HOUSTON, chief technician, production manager, and director in charge of operations, United Refining Co., Warren, Pa., died Nov. 14, 1952, according to a recent report to the Society. Born, San Antonio, Texas, April 18, 1892. Education, BS(EE), University of Wisconsin, 1914; EE, 1916. Mem. ASME, 1946.

Ernest Emmanuel Howard (1880–1953)

ERNEST E. HOWARD, engineer and designer of bridges and senior partner in the firm of Howard, Needles, Tammen & Bergendorff, Kansas City, Mo., and New York, N. Y., designers of the New Jersey Turnpike, died Aug. 19, 1953. Born, Toronto, Ont., Can., Feb. 20, 1880. Parents, Henry A. and Emma (Skipp) Howard. Education, BS, University of Texas, 1900; CE, 1900; hon. DE, University of Nebraska, 1939. Married Josephine Tiernan, 1942. He played a part in the construction of important bridges in 40 states and many foreign countries. At the outbreak of World War II his company was called in by the War Department to make the designs for proving grounds, ordnance plants, and other military projects. He was credited with several inventions relating to bridges and was the author of a number of technical engineering papers and books. Mem. ASME, 1913; Fellow ASME, 1945. He was president of ASCE in 1950 and received numerous prizes for the design beauty of his bridges and roads, including the ASCE Thomas Fitch Rowland Prize. Survived by his wife.

Cyril George Robin Humphreys (1905–1953)

CYRIL G. R. HUMPHREYS, an engineer in the research department, Combustion Engineering, Inc., New York, N. Y., died July 19, 1953. Born,

(ASME News continued on page 948)

REVERE

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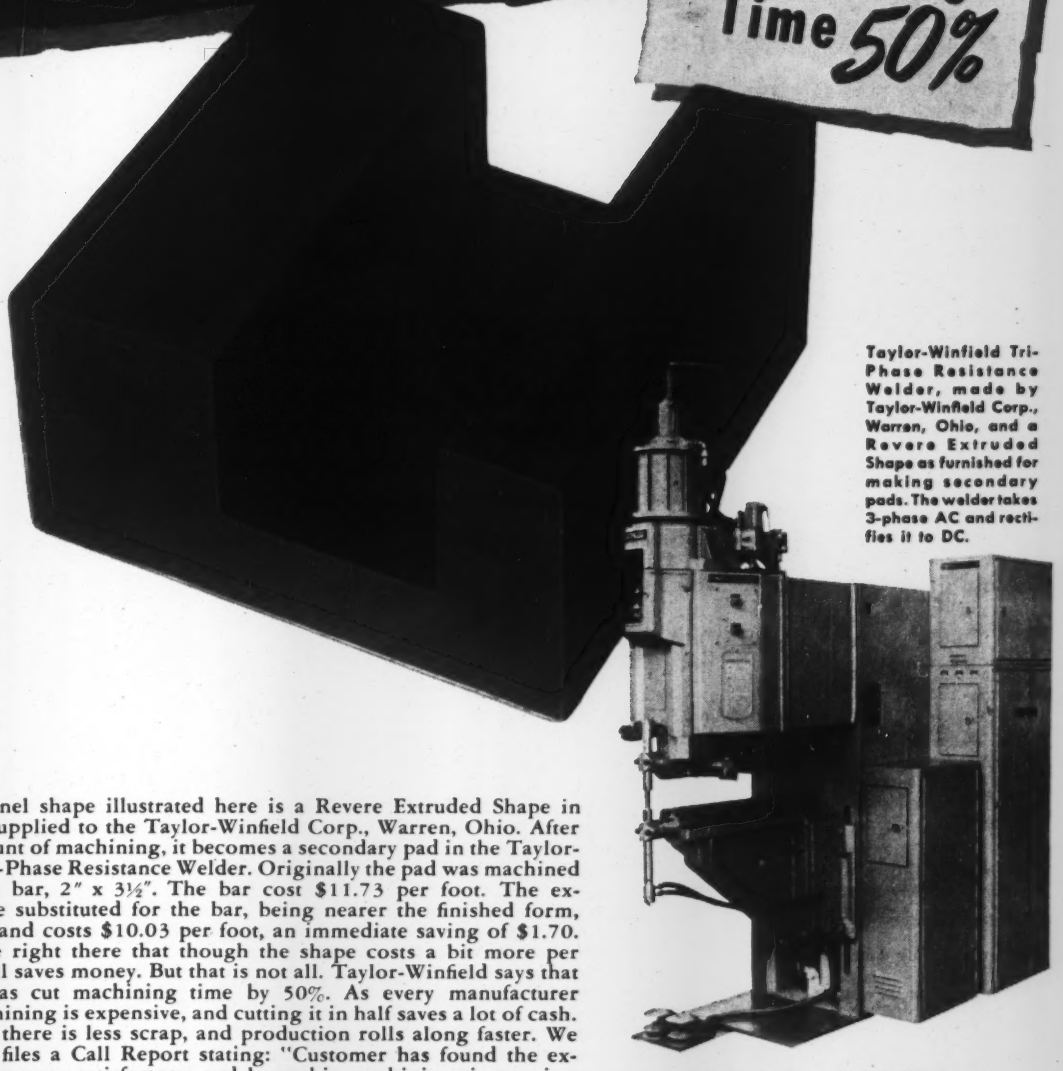

Taylor-Winfield Tri-Phase Resistance Welder, made by Taylor-Winfield Corp., Warren, Ohio, and a Revere Extruded Shape as furnished for making secondary pads. The welder takes 3-phase AC and rectifies it to DC.

● The channel shape illustrated here is a Revere Extruded Shape in copper, as supplied to the Taylor-Winfield Corp., Warren, Ohio. After a small amount of machining, it becomes a secondary pad in the Taylor-Winfield Tri-Phase Resistance Welder. Originally the pad was machined out of solid bar, 2″ x 3½″. The bar cost $11.73 per foot. The extruded shape substituted for the bar, being nearer the finished form, weighs less and costs $10.03 per foot, an immediate saving of $1.70. You can see right there that though the shape costs a bit more per pound, it still saves money. But that is not all. Taylor-Winfield says that the shape has cut machining time by 50%. As every manufacturer knows, machining is expensive, and cutting it in half saves a lot of cash. In addition, there is less scrap, and production rolls along faster. We have in our files a Call Report stating: "Customer has found the extruded section very satisfactory, and bases his machining time-saving on production runs and not estimates."

Credit for this fine achievement has to be shared by a number of people, both in Taylor-Winfield and in Revere. Our Sales and Technical Advisory staffs collaborated closely with the customer's engineering, production and purchasing personnel. Everybody considered all angles, and worked out this money-saving plan.

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London, England, Jan. 16, 1905. Parents, Robin and Clara Georgina Humphreys. Education, graduated in mechanical engineering, Coventry Technical College, 1926; postgraduate work at Columbia University, and Köln University, Germany. Naturalized U. S. citizen, N. Y. District, 1936. Married Carmen Corriols, 1935; children, Melisa, Carmencita. Assoc.-Mem. ASME, 1932; Mem. ASME, 1935. He was a member of the ASME Furnace Performance Factors Subcommittee. He was the author of a number of technical papers on methods of furnace-temperature measurements; also keenly interested in the history of engineering, he wrote a notable series of articles on developments in pulverized-coal firing, which appeared in *Combustion* in 1948. Survived by his wife and two children.

Bertram Augustus Lenfest (1867–1953)

Bertram A. Lenfest, consulting engineer and former head of the metalwork department, Brooklyn, N. Y., Technical High School, who had been an instructor at Massachusetts Institute of Technology, Yale University, and Pennsylvania State College, died Aug. 5, 1953. Born, Lawrence, Mass., June 2, 1867. Parents, Solomon A. and Jennie A. Lenfest. Education, BS(ME) M.I.T., 1890; PhD in Psychology, Yale, 1905; 2 years' graduate work, Harvard University. Married Annie N. Fourkin, 1897 (deceased). Mem. ASME, 1904. He was a fellow of the American Association for the Advancement of Science. Survived by his son, Harold C., Stockton, N. J.; and daughter, Mrs. William Dennison, Bath, Me.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

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☐ D—Materials Handling	☐ M—Production Engineering	☐ W—Wood Industries
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ Y—Rubber & Plastics
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Lawrence Walter Lentz (1913–1953)

LAWRENCE W. LENTZ, copartner, Walter E. Lentz Associates, engineering and architectural consultants, Algonac, Mich., died May 3, 1953. Born, Detroit, Mich., Sept. 6, 1913. Education BS, University of Michigan, 1935; MS, 1936; MS in automotive engineering, Chrysler Institute of Engineering, 1938. Jun. ASME, 1936; Mem. ASME, 1950.

Carleton Wiepking Meyer (1903–1953)

CARLETON W. MEYER, assistant to the president, The Chesapeake & Ohio Railway Co., New York, N. Y., died early this year, according to a notice recently received by the Society. Born, Madison, Wis., Aug. 27, 1903. Education, BA in economics, University of Wisconsin, 1924; LLB, Harvard Law School, 1927. Assoc. ASME, 1946. He was the author of several papers on railway economics.

John Nicholas Pinz (1923–1953?)

JOHN N. PINZ, whose death was recently reported to the Society, was graduated from the University of Minnesota in 1950 with a BS degree in mechanical engineering. Born, Elk River, Minn., Dec. 26, 1923. Jun. ASME, 1950.

Erskine Ramsay (1864–1953)

ERSKINE RAMSAY, mining engineer, industrialist, and philanthropist, died in Birmingham, Ala., Aug. 15, 1953. Born, Six Mile Ferry, Pa., Sept. 24, 1864. Parents, Robert and Janet (Erskine) Ramsay. Education, graduate, commercial technical course, St. Vincent's College, 1883. Mem. ASME, 1925. He was widely known for his accomplishments in coal mining as well as for his inventions, which led to the mining of a higher-grade coal. His best-known invention, which he never patented, was the shaking-screen process. He had patented 40 other devices used in coal mining. In Alabama he was known also for his gifts to educational and charitable causes. In 1937 he received the AIME William Lawrence Saunders gold medal. He received several honorary degrees and many other honors.

Harold Whiting Slauson (1883–1953?)

HAROLD W. SLAUSON, owner of an automotive and marine-instrument service, died according to a notice received recently by the Society. Born, Middletown, N. Y., June 24, 1883. Parents, John W. and Olnia (Wilcox) Slauson. Education, ME, Cornell University, 1907. Married Helen Ford, 1910; children, Lois O., Antoinette W., Ruth W. Jun. ASME, 1908; Mem. ASME, 1923. He was the author of numerous papers and technical articles and had patented a number of marine-engine devices.

Timothy S. Tincher (1873–1953)

TIMOTHY S. TINCHER, consulting engineer, of Germantown, Pa., died July 20, 1953. Born, St. Louis, Mo., 1873. Education, BS in engineering, Missouri College of Engineering, 1892. Mem. ASME, 1937.

Philip Torchio, Jr. (1908–1953)

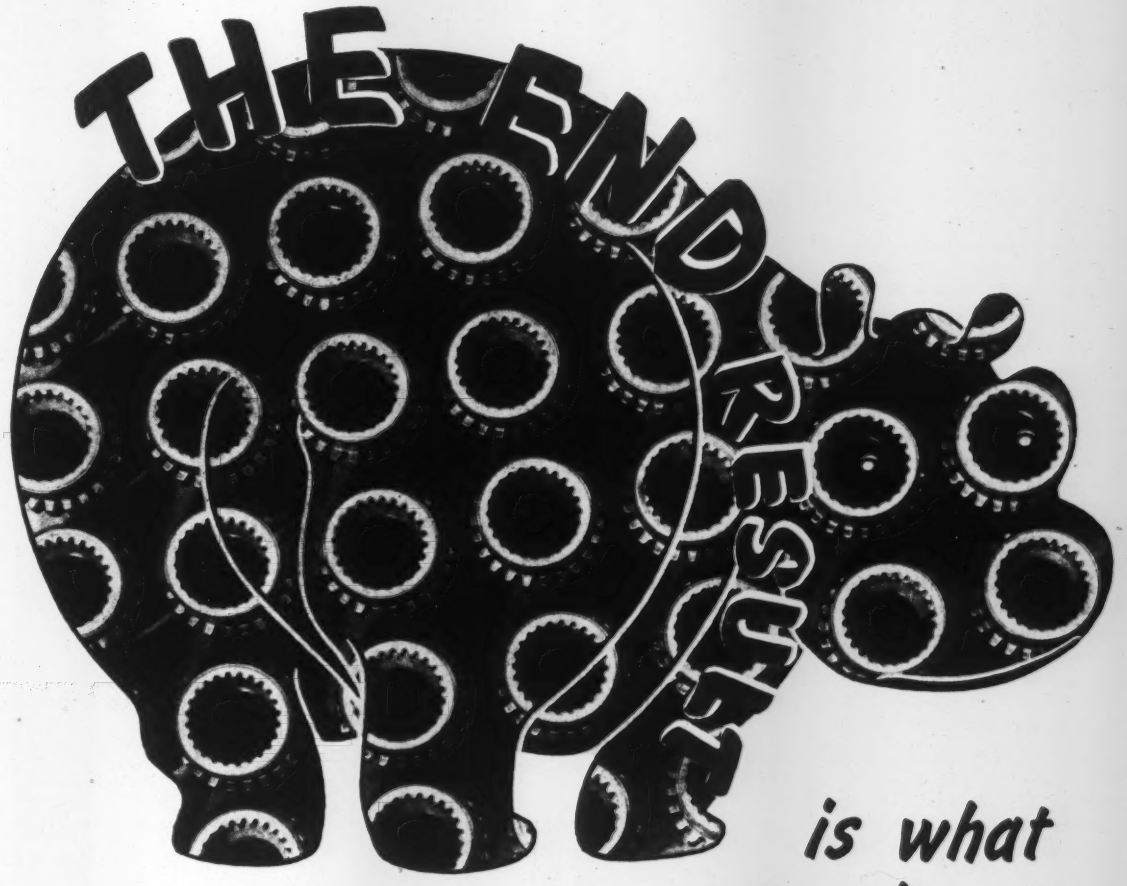
PHILIP TORCHIO, JR., commercial vice-president, American Gas & Electric Service Corp., New York, N. Y., died Aug. 9, 1953. Born, Bronxville, N. Y., July 8, 1908. Education, BS(ME), Massachusetts Institute of Technology, 1930. Mem. ASME, 1949. Survived by his wife, former Muriel Farnum of Providence, R. I.; a daughter Marilyn; a son, Philip, 3rd; his mother, a brother, Brady, New York, N. Y.; and two sisters, Mrs. Richard V. Peterson, New York, N. Y., Mrs. Alfred Mercurio, Santa Clara, Calif. His late father was a vice-president of Consolidated Edison and a former mayor of Bronxville.

Robert Wetherill, Jr. (1881–1953?)

ROBERT WETHERILL, JR., retired engineer of Cleveland, Ohio, died according to an announcement received recently by the Society. Born, Chester, Pa., April 13, 1881. Parents, Richard and Ella (Larkin) Wetherill. Education, CE, Pennsylvania Military College, 1900. Mem. ASME, 1919.

Otto Rudolph Wollentin (1895–1953)

Otto R. Wollentin, manager of equipment design and development at the Westinghouse Lamp Division headquarters, Bloomfield, N. J., died Aug. 19, 1953. Born in Waskowitz, Austria, June 2, 1895. Education, high-school and technical-school graduate. Within the past four years he had made two extended professional trips to Europe and was well-versed in machine developmeet abroad. He held several patents for lamp designs and other applications were pending. Assoc. ASME, 1948.



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JENKINS PRACTICAL PIPING LAYOUTS 70

How to plan an INDUSTRIAL WASTE TREATMENT SYSTEM

In many areas, stringent codes have been drawn up to regulate the types and condition of waste which may be discharged into streams and rivers, in order to conserve existing water supply sources.

Industrial discharges usually require chemical treatment, and one of the most common problems encountered is the neutralization of acid waste. In the system shown here, lime is used as the neutralizing agent. The waste normally flows to a digester which allows for settlement of solids and serves as a storage center. Flow from the digester to the treatment tank is regulated by a liquid level controller.

The treatment tank is equipped with an agitator which mixes the waste with the lime slurry to provide a neutral solution. The proportion of lime to be added is determined by a recording pH regulator, which operates the control valve on the slurry line and admits the required amount of slurry for neutralization. The slurry is made by admitting quicklime and water to the lime slurry mixer, which is equipped with an agitator. Emergency lines for direct discharge bypassing the treatment system are indicated in the diagram.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

Diagram by Huxley Madeheim, Consulting Engineer
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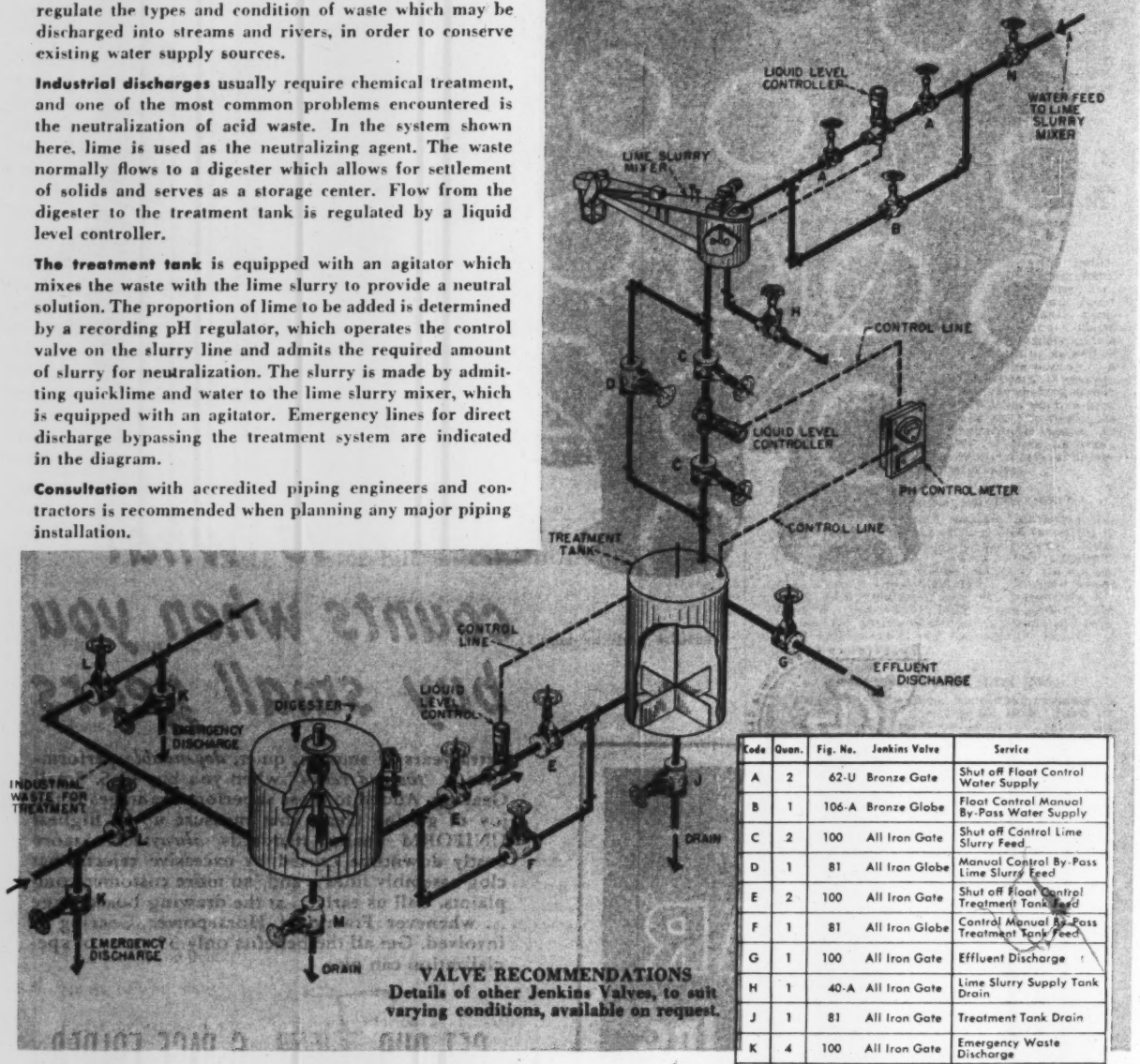

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D	1	81	All Iron Globe	Manual Control By-Pass Lime Slurry Feed
E	2	100	All Iron Gate	Shut off Float Control Treatment Tank Feed
F	1	81	All Iron Globe	Control Manual By-Pass Treatment Tank Feed
G	1	100	All Iron Gate	Effluent Discharge
H	1	40-A	All Iron Gate	Lime Slurry Supply Tank Drain
J	1	81	All Iron Gate	Treatment Tank Drain
K	4	100	All Iron Gate	Emergency Waste Discharge
L	4	100	All Iron Gate	Shut off Waste Lines
M	1	81	All Iron Globe	Digester Drain

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LATEST INDUSTRIAL LITERATURE

1 ALLOWABLE STRESSES FOR PRESSURE VESSELS AND PIPING

Taylor Forge & Pipe Works—The first issue of "Taylor Forge," Vol. 1, No. 1, June, 1953, features reproductions of the allowable stress tables from the ASME Boiler and Pressure Vessel Code and the ASA Piping Code, as well as outlines of the bases on which they were prepared. Included are: Table P-7 from 1952 Power Boilers (Sec. I); Tables UCS-23, UHA-23 and UNF-23 from 1952 Unfired Pressure Vessels (Sec. VIII); Tables 3, 3A, 21, 34, and 34A from Code for Pressure Piping (ASA B31.1-1951 with supplement No. 1 ASA B31.1a-1953). Reviews of recent literature and Standards in the fields of piping and pressure vessels are included, together with information about Taylor Forge and its products.

2 STAINLESS STEELS

Armco Steel Corp.—A concise catalog of stainless steels in all forms except tubing covers the company's technical service, fundamentals of stainless steels, various types, physical and mechanical properties, fabrications, blackening process, and electropolishing. Also the catalog contains brief descriptions of other Armco special-purpose steels and is complete with tables, charts, and illustrations.

3 ALUMINUM EXTRUDED SHAPES

Revere Copper & Brass, Inc.—A booklet on extruded products includes an introduction to the extrusion process and typical Revere alloys. Nomenclature and definitions are given concerning various extruded shapes together with characteristics and standard tolerances. Suggestions regarding design and many illustrations of typical applications are included.

4 SOLENOID-OPERATED ROTATING-DISK VALVE

Ledeen Mfg. Co.—Bulletin 1002 (supplement to Bulletin 1000) covers Ledeen Model PVN valves. These valves are solenoid-operated rotating-disk type, and have three positions: forward, reverse, and neutral. The valves are rated for maximum 150 psi service. Dimensions and weights of models are shown.

5 MULTI-STAGE CENTRIFUGAL PUMPS

Pennsylvania Pump & Compressor Co.—Bulletin No. 237-C describes Thrustfre 2-, 3-, and 4-stage pumps for heads up to 650 psi and with capacities of from 50 to 850 gpm. These pumps are available in both sleeve-bearing and ball-bearing designs for boiler feeding, general power plant, and industrial use.

6 WROUGHT IRON PIPE

A. M. Byers Co.—To assist technicians in design and specification work, a 4-page bulletin contains the most frequently required data on wrought iron pipe. Consolidated tables list size and dimensional data for both standard and extra strong pipe. Complete information on threads per in., mill test pressures, circumference, external areas, length per sq ft of surface area, length per cu ft of volume, gal per lineal ft, and weight of water per lineal ft, is given.

7 STEAM ACCUMULATOR

Foster Wheeler Corp.—An illustrated 8-page bulletin explains the advantages, principles, and applications of the steam accumulator. In addition to instructions on how to calculate required capacity, the booklet includes a full discussion of the practical application of accumulator theory.

8 VALVES

Lunkenheimer Co.—The new 500-page Lunkenheimer Catalog features a three-color illustrated Guide section, where popular valves are grouped by pressure classes for easy comparison. More complete details can be found by referring to the four-way index. Dimensions, prices, and performance data of valves are contained in the catalog.

9 SPROCKETS, BUSHINGS, AND ROLLER CHAIN

Dodge Mfg. Corp.—A new illustrated Bulletin A-624 contains complete data on the new line of Dodge Taper-Lock Sprockets, Taper-Lock Bushings, and Roller Chain for sizes 40, 50, 60, 80, and 100. Technical information and selection data covers a range of pitch sizes of 1/2 in., 5/8 in., 3/4 in., 1 in., and 1 1/4 in., and includes a complete list of Taper-Lock Bushings for bores ranging in sizes from 1/2 to 3 in., inclusive, and the number of teeth in which each size sprocket is available; the complete range is from 9 to 112 teeth. List prices of sprockets, bushings, chains, and links are also included.

10 SPRINKLER SYSTEMS

"Automatic" Sprinkler Corp. of America—"The ABC of Fire Protection" is a 36-page illustrated booklet on the advantages of installing sprinkler systems, emphasizing probable savings in insurance. Operation of various types of fire protection systems is explained and their advantages described. Photographs of buildings and ships using "Automatic" systems are included.

11 STEAM, AIR, AND GASOLINE TRAPS

W. H. Nicholson & Co.—The 32-page, illustrated Catalog No. 953 describes: five types of thermostatic steam traps for pressures to 250 lb; two types of expansion steam traps for pressures to 250 lb; three types of weight-operated traps for steam, air, and gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb; and three types of steam, air, and gas separators. The catalog is complete with capacity tables, installation diagrams, and a section containing data, charts, and formulas for determining the proper size trap for specific applications.

12 INDUSTRIAL ELECTRONIC INSTRUMENTATION

Beckman Instruments, Inc., Berkeley Div.—A 16-page, 3-color bulletin describes the features and applications of the Berkeley line of industrial electronic counters, timers, other instruments, and accessories. Their Engineering Dept. is designing some new units to apply the technique of decimal presentation which is expected to reduce operating time on certain work. Other designs will extend the measurement range and versatility of Berkeley instruments.

13 PLASTIC GEARS

Westinghouse Electric Corp.—Micarta phenolic laminate gear material for silent gear operation, claiming tooth deflection 30 times that of steel, is covered in 16-page book No. B4661 complete with design tables and formulas along with application and machining information.

14 SPHERICAL ROLLER BEARINGS

SKF Industries, Inc.—An improved internal design in its spherical roller bearings is described in a 12-page bulletin. The improvement, available in the Series 222 and 223 bearings, is claimed to increase bearing capacity 25 to 50 per cent and service life 2 1/2 to 3 times. The new design accomplishes roller guiding by a separate ring, which permits longer rollers because of the elimination of integral inner ring flanges and adjacent grinding undercuts. A "window"-type cage is used. Sizes and specifications, with life-expectancy and load-ratio nomograms, are included.

15 METALWORKING MACHINES

O'Neil-Irwin Mfg. Co.—A 32-page catalog describes how Di-Acro precision metalworking machines perform a wide variety of forming, cutting, and punching operations in medium and lightweight materials. Seven basic Di-Acro machines—benders, brakes, notchers, punch presses, rod parters, rollers, and shears are available in 42 hand- and power-operated models. Machine specifications and material capacities are arranged in tabular form for reference.

16 FORCE-FEED LUBRICATORS AND CHEMICAL FEEDERS

Frontier Industries, Inc., Manzel Div.—Collection of booklets describes a line of force-feed lubricators for use with all classes of machinery; includes catalogs on Manzel Models 25, 82, 94, and X spray lubricators and chemical feeders. It also contains details of operation, price lists, ordering specifications, special fittings, and a technical paper on "Forced-Feed Application of Centralized Lubrication."

17 MECHANICAL SPRINGS

Associated Spring Corp.—"The Mainspring," the house organ of its ten divisions, is offered. It contains articles of scientific and practical interest prepared for engineers, designers, and users of mechanical springs. Published bimonthly.

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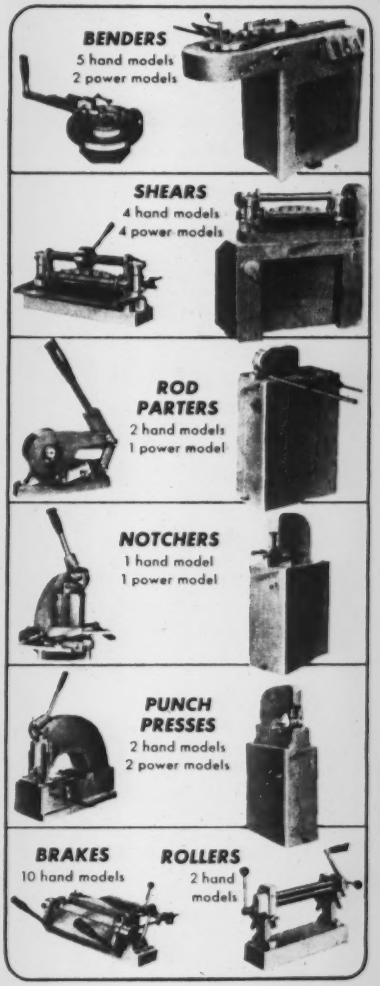

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18 BALL BEARINGS

General Motors Corp., New Departure Div.—"Interchangeable Ball Bearings," 1953 edition, contains conversion tables listing all makes of ball bearings with which New Departure ball bearings will interchange. Also the booklet gives interpretation of prefix and suffix nomenclature, bearing tolerances, and comparative bearing type and series numbering systems.

19 SOLENOIDS

National Acme Co.—Bulletin EM-52 is a 28-page illustrated catalog of Namco "Stellite"-Welded Solenoids, designed with heavy covers and a reference tab for insertion in $8^1/_2 \times 11$-in. files. Specifications, applications, ordering instructions, engineering data, and accessories and parts lists are included.

20 INSTRUMENT TUBING TROUGH

Instrof, Inc.—Bulletin 65-1, 4 pages, describes this method of supporting instrument tubing with expanded metal trough. Standard fittings, such as tees, elbows, crosses, and risers, are illustrated and their important dimensions given. Other accessory items, including connectors, cushion clamps, and reducers, are also listed.

21 HIGH-STRENGTH WELDABLE STEEL

United States Steel Corp.—Folder T-1 describes USS Carilloy "T" steels, designed to have high strength and still retain toughness and weldability superior to other high-strength steels. Mechanical properties are listed and toughness, welding ability, fabricating procedures, and resistance to atmospheric corrosion, wear, and abrasion discussed.

22 NYLON-LINED BEARINGS

Thomson Industries, Inc.—New bulletin describes the Nylined design principle. Bearings consist of thin drawn steel outer sleeve and free floating nylon liner. Now available in ten sizes from $^1/_4$ in. to $1^1/_4$ in. ID, the bearings are intended to provide low-cost solution to common bearing problems. Advantages claimed are that these bearings resist poundout; permit dry operation; are abrasion-resistant, corrosion-resistant, and quiet; dampen vibration; operate in liquids; are close-fit, non-contaminating, low-friction, compact, and lightest in weight; and have a replaceable bearing surface.

23 STEAM HUMIDIFIER

Armstrong Machine Works—Revised 12-page Bulletin No. 1775 explains the operation of unit steam humidifiers. Also included is complete information on capacity and selection data.

24 GROOVING TOOL

Waldes Kohinoor, Inc.—Catalog No. GT2-53 presents general information, engineering specifications, and manufacturing technical data for the Waldes Truarc grooving tool. The manual is illustrated with a number of tool setups and explains the functioning of the tool, particularly its economic performance on recessing operations. It also includes typical applications, dimension and conversion tables, and ordering specifications.

25 COLD ROLL FORMING

Yoder Co.—Equipment and process of cold roll forming; end uses of its products, advantages, and commercial possibilities. Also auxiliary equipment for curving, coiling, ring-forming, making tubular shapes, perforating, welding, embossing, and other operations which can be incorporated in a continuous high-speed cold-forming production line; 88 pages of descriptions and illustrations.

26 FLEXIBLE-SHAFT POWER DRIVES

Elliott Mfg. Co.—Catalog No. 221 describes applications of flexible shafts for power drives and heavy-duty power drives. It gives factors which determine specifications and primary requirements in engineering flexible-shaft power drives. It lists information required by Elliott engineering service in offering solutions to power transmission problems, without cost or obligation.

27 WATER-TUBE BOILER

Murray Iron Works Co.—Bulletin B-114 covers the Murray Type WTE single-drum side-header water-tube boiler. The shop-assembled unit has a steel casing, integral sub-base, with refractories and insulation requiring only a concrete pad for foundation. The furnace is water-cooled and the side-headers afford ample water supply to water wall tubes, the company declares, while the drum is

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supported on a tube bank eliminating suspension steel. The unit is symmetrical in design with provision for cleaning, and is available in sizes from 7800 to 40,000 lb.

28 ELECTRICAL WIRING CONDUIT

American Brass Co.—Bulletin UA-530 describes first Type UA flexible liquid-tight conduit to gain Underwriters' Laboratories approval for use in wet locations. Made with a flexible galvanized steel core, positive ground, and tough synthetic cover, "Sealtite" conduit protects wiring against moisture, dirt, chemicals, and corrosive fumes. Suggested applications and specifications are included.

29 AUTOMATIC-CONTROL DRIVE UNITS

Leeds & Northrup Co.—A folder describes electrically energized drive mechanisms for automatic control applications. The unit is inherently self-locking and can't be back-driven. It has an output torque from 25 to 2500 lb-ft and is available with slidewire for remote-position indication.

30 SOLENOID PILOT VALVES

Valvair Corp.—A new 8-page illustrated Bulletin "P" describes a new Valvair solenoid pilot valve for controlling air, vacuum, oil, and water. Mechanical drawings show 2-way, 3-way, and 4-way single and double models, with exhaust port plugged for manifold mounting and for other applications. Complete parts are listed for all models, together with parts numbers and designations on drawings.

31 PISTON RINGS

Koppers Co., Inc., Piston Ring Dept.—A 16-page folder describes Koppers "American Hammered" piston rings for industrial use. Individual ring types shown with specifications for use in combustion engines, hydraulic systems, compressors, etc.

32 DRAFTING EQUIPMENT

Frederick Post Co.—Illustrated colorful 170-page catalog describes a complete line of print-making products, tracing papers and cloths, drafting materials, and equipment for the drafting room, as well as supplies and equipment for the field engineer. Unique indexing system finds desired information.

33 REVOLVING UNIT HEATERS

L. J. Wing Mfg. Co.—Bulletin HR-6 describes revolving unit heaters which feature a revolving air-distributor with one or more outlets. Models are available for steam, hot water, and electric and gas heat supply in a full range of sizes. Design and construction details are supplemented by tables of engineering and fabrication data.

34 COMPRESSOR

Clark Bros. Co., Inc.—Bulletin No. 113 describes the features, construction details, specifications, and dimensions of the Model HLA compressor. This is the latest addition to the line of "Big Angle" gas-engine-driven, 2-cycle compressors and is available in 5-, 6-, 8-, and 10-cylinder models. It has a 17-in. bore, 19-in. stroke and delivers 250 bhp per power cylinder at 300 rpm.

35 LOCK NUTS AND LOCK WASHERS

Standard Locknut & Lockwasher, Inc.—Bulletin No. 30 describes Standard's line of lock nuts and lock washers for ball- and roller-bearing applications, designed to SAE and ABEC applications. Dimensions of lock nuts, lock washers, and shafts are included.

36 HYDRAULIC PUMPS, MOTORS, TRANSMISSIONS

Oliver Iron & Steel Corp., Berry Div.—Catalog No. 5209 describes the Berry hydraulic principle used in its motors, pumps, and transmissions. Diagrams illustrate its operation. Hydraulic circuits with motors, pumps, and transmissions are included, together with motor and pump ratings and engineering information.

37 DRAWING-INK FOUNTAIN PEN

John Henschel & Co., Inc.—A booklet describes the Pelican Graphos, a drawing-ink fountain pen with 58 interchangeable nibs. The pen will draw a uniform line from hairline thickness to $\frac{3}{8}$ in. and is ideal for technical drawing, sketching, stenciling, and lettering. Filling time is reduced because of the ink fountain advantage.

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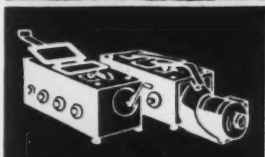
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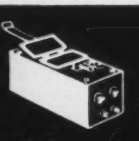
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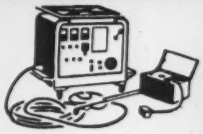
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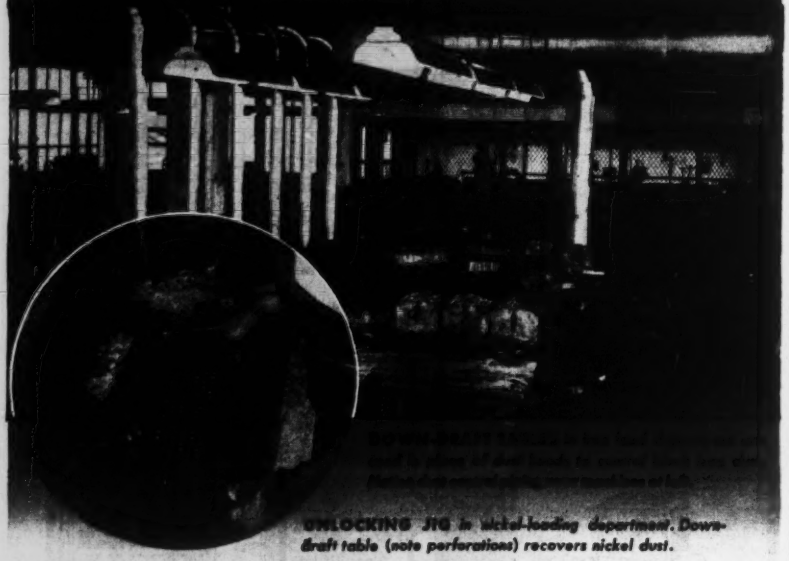

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38 INDUSTRIAL SCALES

Toledo Scale Co.—A condensed catalog of the 1953 line of Toledo Industrial Scales illustrates and describes briefly the full range of fan, bench, portable, floor, motor truck, and overhead type of scales. It also covers counting scales and comparative reference data to facilitate selectioning.

39 MOTORS AND CONTROLS

General Electric Co.—Buying information on a carefully selected group of GE fractional- and integral-horsepower motors, motor starters, control accessories, and electronic controls is contained in a 54-page catalog. The manual graphically presents product features, dimensions, weights, and pricing information.

40 COAL SCREW-CONVEYER

Canton Stoker Corp.—Pamphlet shows how Flo-Tubes can save shoveling and manpower in handling coal. Illustrations point up automatic and money-saving applications of screw conveyers for coal but mention that Flo-Tubes are practical for any bulk product. Auxiliary products and stoker developments are also described.

41 HEAT EXCHANGER

Bell & Gossett Co.—Catalog No. DM-1150 contains an extensive table of applications to various industries of heat exchangers, heaters, coolers, and condensers, together with specifications and detailed applications of B & G's principal models. Refrigeration equipment, centrifugal pumps, gas coolers, and water heaters are included. Eight pages of engineering data are in the 28-page booklet.

42 INDUSTRIAL POWER AND PROCESSING EQUIPMENT

Schutte & Koerting Co.—Bulletin SK-1 lists the complete line of SK Equipment and their descriptive bulletins. Some of the general product listings include jet apparatus, pumps, condensers, valves, strainers, heat-transfer apparatus, oil-burning equipment, and instruments for indicating, controlling, and recording the flow of fluids. Special products, such as moisture eliminators and separators, are also listed.

43 BEARING-SURFACE MATERIAL

Formica Co.—Booklet outlines the advantages of Formica and grain material in solving friction-reducing problems. Claimed to be stronger, wear longer, and carry heavier loads than cast iron, it is recommended for bearing-surface applications. Instructions are given for preparing and installing the material, and specifications shown for adopting Formica to machine tool ways, both flat and V bearing-surfaces.

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44 ANTI-FRICTION PILLOW BLOCK

W. A. Jones Foundry & Machine Co.—Catalog 88 describes in full detail the complete line of Jones Timken-equipped pillow blocks for shaft sizes from $1^{15}/_{16}$ in. up to 9 in. in expansion and non-expansion types. Taper adaptor-sleeve principle and labyrinth grease-sealing arrangement are illustrated and described. Detailed application information including dimensions, capacities, life, and service factors are given.

45 CONTROL VALVES

Hydropress, Inc.—Bulletin L-43, issued by Loewy-Hydropress, with illustrations descriptive of water-hydraulic high-pressure controls, deals with hydraulic control valves, pre-filling valves, stop valves, check valves, by-pass valves, shut-off valves for hydraulic accumulators, and combination valves for sequence operation.

46 FLEXIBLE COUPLING

Ajax Flexible Co., Inc.—Bulletin 52 describes a new spline or gear-type coupling designed to handle more shaft misalignment than conventional flexible couples. The bulletin includes dimension tables, engineering diagrams, service factors, and ordering specifications.

47 CONTINUOUS-CLEANING SPREADER STOKER

Detroit Stoker Co.—Catalog on the Type C-C Roto-Stoker describes the operation of the spreader stoker, available in a range of sizes and designed for firing all makes and types of modern boilers and steam generators, from approximately 5000 to 75,000 lb per hr steam output capacity. It has all of the design features of RotoStokers now available with intermittently cleaning dumping grates and stationary grates, but with the additional advantage of automatic and continuous cleaning of the fuel bed. The ash is continuously discharged at the front for removal either at the operating floor level or from the ash hopper below.

48 LUBRICATION

Fiske Bros. Refining Co., Lubriplate Div.—The 56-page 1953 edition of Lubriplate Data Book contains much information in connection with improving machine operation and reduction of maintenance costs through specialized lubrication.

49 NEOPRENE AND SPONGE RUBBER SHEETS

Johns-Manville, Van Cleef Bros., Inc., Div.—New technical data sheets concern Dutch Brand Natural Sponge Rubber in soft, medium, firm and hard densities to meet ASTM specifications No. D1056-51T; RN11, RN12, RN13, and RN14; Neoprene in soft and medium densities to meet ASTM specifications SC11 and SC14. Standard colors are brown, gray, red and green, and special colors. Thicknesses $^1/_8$ in. to 1 in. inclusive, rolls, sheets, strips with or without adhesive; die cut forms and custom molded pieces.

50 TEST BOILERS

Besler Corp.—Test boiler bulletin, illustrated with photographs, drawings, and dfagrams describes Besler high-temperature, high-pressure boilers. Designed by test engineers, these boilers are sectional, an innovation offering maximum flexibility, utmost weight and space conservation, and high efficiency. Bulletin contains specifications on 14 models with a range of capacities said to be heretofore impossible to attain.

51 AIR CONDITIONING AND HANDLING

Westinghouse Electric Corp., Sturtevant Div.—Catalog 600 contains a 21-page equipment section, a 14-page applications section, and a 16-page engineering data section. The equipment section contains condensed specifications, dimensions, and descriptions of the Westinghouse-Sturtevant fans, heating and ventilating units, electronic air cleaners, and air-conditioning equipment. The applications section relates equipment capabilities to job requirements; the engineering data section contains numerous tables of such information as relative characteristics of centrifugal fans, average air velocities for exhaust hoods, air requirements for the combustion of oil, gas, coal, and wood, properties of saturated steam, and flow of air through an orifice.

52 ADJUSTABLE PIPE HANGERS

Blaw-Knox Construction Co., Power Piping Div.—New 100-page Catalog 51 features the Blaw-Knox functional spring hangers, vibration eliminators, and overhead roller assemblies. The improving and simplification of complicated piping systems is

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explained by charts and drawings. A Technical Section enables a piping engineer to solve most hanger load problems and thus determine the hanger requirements for the particular piping under consideration.

53 TANK HEATING AND COOLING

Tranter Mfg., Inc.—Savings achieved by 13 companies as a result of replacing pipe coils with "Platecoils" in heating and cooling processes are described in a 20-page brochure. Booklet tells how Platecoils save as much as 50 per cent in initial cost, heating and cooling time, tank space, and maintenance.

54 SELF-ALIGNING COUPLINGS

Koppers Co., Inc., Fast's Coupling Dept.—Six-page folder on Fast's self-aligning couplings gives graphic illustrations of principles and features of these couplings; table of utility factors for various kinds of connected machines; and tables of rating for standard forged-steel couplings and heavy-duty-type couplings.

55 INDUSTRIAL METER SELECTION

Rockwell Mfg. Co.—A new bulletin, No. OG-400, intended to guide the proper selection of meters for measuring more than 200 chemicals, petroleum products, and other liquids with varying corrosive characteristics, is available. In addition to the complete table of metered liquids matched with case, chamber, and piston specifications, the bulletin also includes a simplified specification sheet which makes it easy for the customer to cover all necessary operating requirements so that proper meter recommendations can be made at the factory.

56 PRESSURE VESSELS

Scaife Co.—Pressure vessels for air, water, and gases are illustrated and described. Data for both horizontal and vertical types are given.

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57 ELECTRIC MOTORS

Westinghouse Electric Corp.—Booklet B-4731 describes the new Life-Line motors which are available up to 700 hp for all industry. Especially designed to eliminate excessive working costs and to give top electrical performance, these Life-Line motors are constructed in steel for greater protection against shock and strain. Drip-proof, splashproof, and vertical motors are features in this booklet.

58 CHAIN COUPLING

Morse Chain Co.—Catalog C 45-49 describes Morse's complete line of roller and silent chain flexible couplings with horsepower ratings, dimensions, construction, etc. Special silent and roller chain couplings are illustrated and described.

59 DRAFT GAGES

Ellison Draft Gage Co., Inc.—Bulletin 152 gives quick briefing on firm's line of diaphragm-type and bell-type straight line pointer and dial draft gages, inclined tube and vertical tube draft gages, air filter gages, portable gas analyzers, U-path steam colorimeters, saturator gages, and pitot tubes.

60 BOILER SERVICE VALVES

Everlasting Valve Co.—Bulletin describes the Everlasting Quick-Opening and Slow-Opening Straightway Valves, Angle Valves, Y Valves, and Duplex Blow-Off Units, with specifications, materials of construction, and dimensions of each type. Illustrations include details of design, sectional and exploded views, and explanations of operation of the valves. A section of the bulletin also describes Everlasting valves for fire protection.

61 DIESEL ENGINES

Hercules Motor Corp.—A booklet of engineering specifications and manufacturing data is offered on a line of 2-, 4-, 6- and 8-cylinder diesel engines. This 14 Series includes Bulletins Nos. D-162, D-164, D-142, D-143, D-136, D-147, D-165, D-166, D-134, D-161, D-170, D-148 and D-167, bound together, showing power chart, installation diagram, and general data for 29 models.

62 REMOTE CONTROL

American Chain & Cable Co., Inc.—Bulletin No. DH-287 entitled "The Key to Remote Control—Tru-Lay Push-Pull Flexible Controls" describes

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applications of various types of push-pull remote controls for installations ranging from delicate instruments to heavy earth-moving equipment. There is a question-and-answer section pertaining to construction, efficiency, backlash, deflection, temperature ranges, and weather resistance.

63 ELECTRIC HEATING UNITS

Edwin L. Wiegand Co.—Catalog 50 covers specifications, construction details, application data, and prices of their complete line of electric heating units. Models are available with strip, ring, tubular, and cartridge heating elements. Also described are immersion, circulation, radiant, and forced-air duct heaters. Charts and tables are provided for selection of the various units.

64 GAGES

American Machine & Metals, Inc., U.S. Gauge Div.—Catalog 64 provides 68 pages of illustrated information describing air-volume controls for pump installations, vapor-tension thermometers, d-c ammeters and voltmeters, water flow meters and gages of all types. Engineering information is included.

65 FLEXIBLE, SWIVEL, SWING, AND REVOLVING JOINTS

Barco Mfg. Co.—A group of catalogs cover flexible, swivel, swing, and revolving joints for piping and lines conveying steam, oil, air, gasoline, water, chemicals, including corrosive acids and alkalies, and other fluids or gases. Types cover pressures up to 750 psi, steam, and 7500 psi hydraulic. Complete range of sizes. Catalogs No. 215 "Flexible Ball Joints;" No. 265 "Rotary Swivel Joints;" No. 400 "Barco Swing Joints;" No. 300 "Revolving Joints."

66 STEEL DOORS

Kinnear Mfg. Co.—Bulletin No. 75, 32 pages, illustrated, covers steel rolling and other types of Kinnear Doors. One section describes a galvanized-steel sectional overhead-type door that combines durability with operating convenience; facilities for glass light-sections in a door for all types of commercial and industrial service openings are offered. The bulletin gives details, clearance requirements, and available accessories.

67 CAST STEEL GATE VALVES

Edward Valves, Inc.—A new 6-page catalog section contains complete information on details of design, material specifications, pressure and temperature ratings, and dimensional details and weights of a new line of cast steel gate valves. Features of gate valves described include close-fitting guide ribs, one-piece bonnets, and ball bearing yokes. A special testing procedure designed to assure two tight-fitting faces is also described. Items cataloged include cast steel gate valves in 300-, 600-, 900-, and 1500-lb sp classes. All are furnished in sizes from 2½ in. through 12 in. Flanged or welded ends are provided.

68 VANEAXIAL FANS

Joy Mfg. Co.—Bulletin J-611 describes the Axivane Series 1000 fans and explains the advantages of vaneaxial design and the versatility of adjustable blades. Series 1000 has 136 models, 18 to 84 in. in diameter, and producing volumes up to 150,000 cmf at total pressures as high as 11.0 in. wg. Fans are available in 19 housing diameters, four hub sizes, and five motor speeds. Specification tables are included.

69 DIE CASTINGS

Aluminum Co. of America—"Designing for Alcoa Die Castings" is a 190-page book on aluminum and magnesium die castings. The book covers advantages of aluminum and magnesium die castings, die-casting machines, choice of alloys, design factors and elements, machining and finishing die castings, and inspection and testing. A glossary of die-casting terms and an index complete the book.

70 CENTRIFUGAL BLOWERS AND EXHAUSTERS

U. S. Hoffman Machinery Corp.—New Bulletin A-932 describes design and performance features of the Hoffman multi-stage centrifugal blowers and exhausters for 1 to 9 psi pressures or vacuum from 2 to 12 in. of mercury. It lists 17 industrial applications including several on which savings can be made by replacing high-cost compressed air formerly considered necessary. Also included are typical performance curves and data check lists for optimum blower or exhauster specifications.

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71 OIL BURNERS

Cleaver-Brooks Co.—Oil Burner Catalog No. AD-102 includes a description of the Hev-E-Oil Burners for industrial, commercial, and institutional installations. The catalog lists features, shows typical installations and applications, covers design construction and efficiency, and contains brief capacity and dimension listing.

72 PACKLESS EXPANSION JOINTS

American District Steam Co., Inc.—Bulletin 35-51A gives design and construction data on a line of packless expansion joints using either copper or stainless steel as the main element. Special illustrations show typical installations and a wide range of flexibility in possible piping designs. Also included are installation data and numerous charts and tables to facilitate selection.

73 WELDMENTS

Graver Tank & Mfg. Co., Inc.—A 16-page illustrated booklet describes the range of welded products manufactured by Graver for heavy industries. The company offers a design and engineering service by its welding research laboratory for problems of welded sub-assemblies and machine components. Applications include material involving close tolerances in steel and alloys 1/4 to 12 in. in thickness.

74 HYDRAULIC PUMPS

American Engineering Co.—Hydramite Bulletin No. 3 describes a constant-displacement oil fluid power pump capable of delivering 3, 5, and 10 gallons per minute under pressures up to 5000 psi.

75 BRAKE MOTORS AND BRAKES

Elliott Co., Crocker-Wheeler Div.—New pamphlet shows the features of the C-W Brake, emphasizing simplicity and dependability. The disk brake has bonded-metal linings and is available separately or in combination with both a-c and d-c motors. Diagram shows working detail and tables give dimensions and data used in selection.

76 ELECTRIC MEASURING INSTRUMENTS

Westinghouse Electric Corp.—Booklet B-4696 covers the Westinghouse line of electrical measuring instruments for industry—portable, panel, switchboard, socket, and recording—for measuring all electrical quantities. This fully illustrated booklet also tells how to select, apply, and order Westinghouse instruments.

77 HEATER PANEL OVENS

Jensen Specialties, Inc., Advance Heating Div.—Second edition of catalog "Jensen Pan-L-Heat Ovens" describes its line of heater panels and heater panel oven assemblies, with specifications and advantages. Flexibility of the heater panel oven system is emphasized, and a method for cost calculation of energy is shown.

78 BALL AND ROLLER BEARINGS

Aetna Ball and Roller Bearing Co.—Latest 52-page catalog gives specifications on Aetna's full line of standard ball thrust bearings, clutch release gearings, ball retainers, and hardened and ground washers. Contains technical data for design engineers, useful calculations and formulas, important application principles, fundamentals of proper lubrication, bearing selection and care.

79 O-RINGS

Linear Inc.—Compact 6-page folder contains tables of standard O-ring sizes as well as dimensional data for installation. Notes contain general recommendations on clearances, design, material, machining, and finishes for most O-ring applications. A special compound bulletin describing the latest polymers and synthetic rubbers from which O-rings can be moulded is also included.

80 SPECIAL-PURPOSE REFRACTORIES

Carborundum Co.—A 40-page booklet, "Super Refractories for Heat Treatment Furnaces," describes the characteristics of these refractory materials, and shows examples of how they are used in various furnaces. Among furnaces covered are artificial atmosphere, salt bath, sheet and strip annealing, car-type annealing, etc.

81 VENTILATING FANS

Robbins & Myers, Inc., Propellair Div.—Latest catalog, Form 3238, describes uses of various types of Propellair ventilating fans such as tubeaxial, vaneaxial, Sky-Blast, belt-driven, pulley-driven, etc. Typical modern industrial applications of Propellair equipment are pictured.

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82 ANNUNCIATOR SYSTEM

Panalarm Products, Inc.—The Panalarm "50" Annunciator system is described in Bulletin 100. The advantages of flexibility and standard interchangeable units are explained. Wiring diagrams of different annunciator sequence circuits and explanations of the different sequences possible are contained in the bulletin. Excerpts from the 1947 National Electric Code are quoted regarding locations and equipment.

83 BLACK AND WHITE PRINTS

Charles Bruning Co.—An 8-page booklet "The Copyflex Process" gives a description of the diazo copying method and its applications in business and industry. Bruning's Copyflex machines and sensitized materials for every copying requirement are explained in detail.

84 SURFACE PYROMETER

Cambridge Instrument Co., Inc.—Bulletin 194SA describes three surface pyrometers for temperature determination: roll, for still or moving rolls; needle, for insertion into materials in a plastic or semi-plastic state for within-the-mass temperature determination; and mold, for checking surface temperature of mold cavities and surfaces of almost any contour.

85 TECHNICAL BOOKS FOR ENGINEERS

Ronald Press Co.—Catalog contains detailed descriptions of over 100 technical books on mechanics, engineering, aeronautics, industrial management, metallurgy, applied and physical sciences, etc. Practical reference works like the Ronald Handbooks, basic studies, and pioneering works on the latest engineering and scientific developments are included.

86 FAN EQUIPMENT

Clarage Fan Co.—New Service Manual shows how to properly install, operate, and maintain Clarage fans, blowers, and air conditioning units. Manual contains 68 pages of useful information, valuable to any engineer or maintenance man who has fan problems.

87 STEAM TURBINES

Terry Steam Turbine Co.—Bulletins in looseleaf form which cover a complete description of Terry solid wheel turbines with cross section drawings of typical units for both moderate and high steam pressure conditions: a description of the Terry axial flow impulse, both single stage and multi stage; Terry gears which are used for speed increasing and speed reducing.

88 LPD STRAINERS

J. A. Zurn Mfg. Co.—Several types of LPD (Low Pressure Drop) Strainers for all purposes and ranging in sizes from 1/2 to 24 in. are described and illustrated in this 16-page Data Manual No. 952. It carries information concerning the factors to be considered in selecting strainers for a specific application, and the effect of flow rate, screen loading, and the viscosity of fluid on pressure drop.

89 SPUN END PROCESS

Calumet & Hecla, Inc., Wolverine Tube Div.—Brochure describes the distinctive Spun End Process. In 28 pages it tells a concise story of a revolutionary metal-forming process that is highly efficient and relatively inexpensive. A quick comprehension of the process is gained through the many photographs, diagrams, and descriptions that make comparisons between old and new methods.

90 HIGH-PRESSURE PUMPS

Royalton Co., Inc.—Bulletin No. 151 describes Royalton Hi-Pressure industrial pumps, duplex from 3 1/2-gpm capacity and 350-psi pressure to 15-gpm capacity and 600-psi pressure; and quadruplex from 25-gpm capacity and 700-psi pressure to 60-gpm capacity and 800-psi pressure. Features of the pumps are examined individually. Specifications and performance characteristics included.

91 LETTERING MACHINE

Ralph C. Coxhead Corp.—Bulletin tells how Vari-Typer lettering machine offers fast method of lettering bills of material, notes, specifications on tracings and drawings, and countless other drafting-room lettering details. A few of the many styles of instantly changeable type are illustrated.

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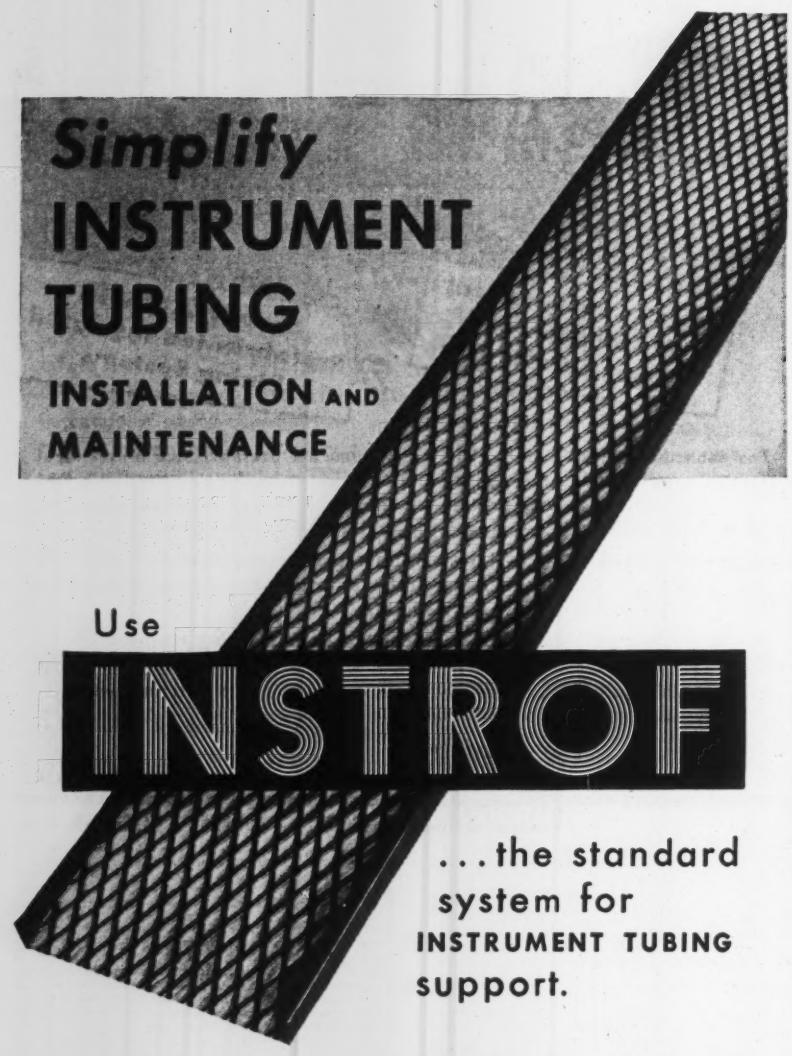

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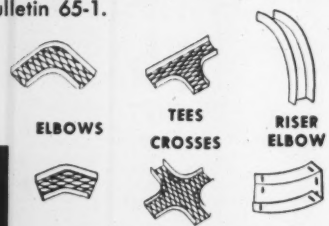

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92 HYDRAULIC FLOW CONTROL

Denison Engineering Co.—Bulletins V F C give complete data on a new flow control that provides full-scale regulation of adjustable-speed circuits regardless of pump delivery, and optional range of min.-max. adjustment to 3000 psi without changing spools. Two- and 3-port types are listed for 0 to 28 gpm and in sizes 1/4 in., 3/8 in., and 3/4 in.

93 CRUSHING HANDBOOK

Pennsylvania Crusher Co.—General booklet gives information on how to make the most efficient and satisfactory application of various types of crushers to specific jobs. It contains information on power consumption, parts wear, maintenance costs, and uniformity of product, and includes a check list that tells how to determine the best type of crusher for various jobs.

94 VARIABLE-SPEED DRIVES, CONTROLS

Reeves Pulley Co.—Bulletin G-509-1 describes the complete Reeves line of variable-speed transmissions, Vari-Speed Motodrives, and Vari-Speed motor pulleys. Special types of controls adaptable to these drives also are described. Overall dimensions of standard Reeves equipment, horsepower capacities from fractional to 87 hp for Reeves drives, and a section devoted to general engineering information are included.

95 HYDRAULIC PUMPS AND MOTORS

Commerical Shearing & Stamping Co.—Performance characteristics of PD series single oil hydraulic pumps furnished in gear widths 1/2, 3/4, 1, 1 1/2, 2, 2 1/2, and 3 in. are recorded in charts and tables. Horsepower input and gallonage discharge are shown through a pressure range from 0 to 1500 psi and a speed range up to 3000 rpm. Also, performance characteristics of MD series single oil hydraulic motors furnished in gear sizes 1, 1 1/2, 2, 2 1/2, and 3 are given in charts and tables. Gallonage input and corresponding horsepower delivery are shown through a pressure range from 0 to 1400 psi over a speed range up to 1200 rpm.

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96 CENTRALIZED LUBRICATION SYSTEMS

Lincoln Engineering Co.—Catalog 80 describes its lubrication application equipment for centralized lubrication systems and lists the combinations of units available for various combinations of capacity and automatic and manual control and timing. Specifications of basic and accessory equipment are included.

97 PIPING FABRICATION AND ERECTION

Dravo Corp.—A 24-page illustrated booklet, Bulletin No. 1700, shows piping installations in steel mills, for gas transmission systems, central power stations, water pumping stations, heating plants, oil refineries, and chemical process plants. Dravo's engineering and fabrication facilities are also illustrated and described.

98 PACKAGED AUTOMATIC BOILERS

Orr & Sembower, Inc.—Bulletin 1219 describes Powermaster packaged automatic boilers in sizes from 15 through 500 hp for steam process and steam and hot-water heating service. The first portion of the bulletin covers the construction features of boilers of this type. Detailed specifications describe the boiler, burner, and control systems. Several typical installations are included.

99 GENERAL PURPOSE TURBINES

Westinghouse Electric Corp.—Bulletin No. B-3896. The type-E turbine is said to do a number of jobs well even under abnormal operating conditions. Designed for economy and dependability in continuous or stand-by operation, the turbine is a means of effecting steam expansion without loss of energy. Fully illustrated and diagrammed.

100 DIES AND CUTTING TOOLS

General Electric Co., Carboloy Dept.—A new die Catalog, D-130, has a complete description of standard and special wire-, bar-, and tube-drawing dies. A tool manual, GT-191, gives "how-to" information on use of tungsten-carbide cutting tools. A general tool catalog, GT-265, offers complete information on Carboloy's cutting tool line. Additional catalogs are available on other Carboloy products, such as coal mining tools.

101 SPEED-MEASURING INSTRUMENTS

James G. Biddle Co.—Bulletin 35-50 describes resonant reed, centrifugal, and chronometric types of speed-measuring instruments, with 28 pages devoted to the selection, operation, and illustration of Frahm, Jagabi, Jones, and Dr. Horn instruments. Also featured are repair and engineering services available.

102 TUBE FITTINGS

Parker Appliance Co.—Catalog 4300 provides a full description of Triple-lok flare tube fittings and Ferulok flareless tube fittings, as well as tube-fabricating tools and equipment. Included are sections on use of tools and selection of tube sizes and materials according to operating conditions.

103 PULVERIZER

Kennedy Van Saun Mfg. & Eng. Corp.—Bulletin 44-C describes the Kennedy air-swept ball tube pulverizer, which does fine grinding of all materials including coal at capacities up to 50 tons per hour, availability nearly 100 per cent. Moisture is evaporated in the mill during pulverization. No magnetic separator is employed and low maintenance is guaranteed, according to the manufacturer.

104 AIRCRAFT CONTROL BEARINGS

Chain Belt Co., Shafer Bearing Div.—Fully illustrated catalog devoted exclusively to the Shafer line of aircraft roller bearings which are available in a full-size range of standard (specials to order) self-contained, single-row, double-row, and rod-end types for all conventional control applications for all types of air-borne craft. Contains complete specifications, engineering and application data and relative merits of the basic Shafer ConCaVex design which employs concave rollers and convex races.

105 FLEXIBLE SHAFTS

Stow Mfg. Co.—Engineering Bulletin No. 525 and Slide Torque Calculator show how to select the correct size and type power-drive flexible shafts for any application (maximum capacity 1500 lb-in.). Also given is the necessary data for selecting remote-control flexible shafts (maximum capacity 4000 lb-in.).

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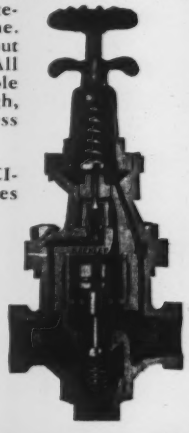
Here is a unique Keckley feature that means extra convenience and savings for you. The pilot valve can be removed as a unit. This means easy inspection, maintenance or replacement in a few minute's time. No bother with separate parts—comes out as easily as the spark plug in your car. All other parts of this valve are readily accessible too! All wearing parts are made of tough, long wearing, corrosion resistant stainless steel, further lowering upkeep.



Check into the Keckley line of PRECISION PRESSURE REGULATORS. Sizes ½" to 6"—pressure to 300 lbs. steam, 600 lbs. air, reduced to a low of 1 lb. Various combinations for pressure and temperature control. Ask our representative, your industrial distributor, or write.

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106 TORQUE-TESTING FIXTURE

P. A. Sturtevant Co.—A new torque-testing fixture for making ultimate-torsional-strength tests, open-hole torque tests, and driving and stripping tests of various types of screws is described in Bulletin TTF-53. Applications, such as checking strength and thread-cutting ability of taps, and strength of screw-driver bits and socket wrenches, and complete specifications are given. Special-application testing fixtures, SPT Model Push-Off Fixture, SPT Model Sensitive Compression Tester, SPT Model Hair-Spring Torsion Tester, etc., are included in the bulletin.

107 WELDED STEEL TUBING

Brainard Steel Co.—An 8-page pamphlet gives fabrication data and advantages of welded mechanical and structural steel tubing. Because a tubular section will carry a greater torsion load than any other shape, it is recommended for vertical loading. Bulletin also includes a list of typical applications and tables show weight per linear foot, size tolerance, and gage tolerances.

108 TECHNICAL BOOKS

John Wiley & Sons—Revised 1953 catalog on mechanical engineering books is available, containing information on over 75 titles. Fields covered are machine design and mechanism, materials handling, production, thermodynamics and steam power, pumps, combustion, heating and ventilating, and related subjects.

109 ELECTRIC VIBRATING FEEDERS AND CONVEYERS

Jeffrey Mfg. Co.—Catalog 830 gives detailed description of basic design and operating principles, specific technical information, and typical installations of a line of electric vibrating feeders and conveyers which contain no mechanical wearing parts. No lubrication is claimed necessary. The feeders and conveyers handle materials in capacities ranging from ounces to 2,000 tons under a variety of conditions. Special application models include tubular, for dust-tight and fine-flooding materials; water-cooled, for hot furnace feed or hot materials handling; spreading and spark-proof feeders; etc.; and associated products such as packers, bin check valves, level indicators, magnetic separators, elevating and conveying machinery, crushers, pulverizers, and shredders.

110 COPYING EQUIPMENT

General Aniline & Film Corp., Ozalid Div.—"Hundreds of Uses" is a new, 48-page booklet describing Ozalid's uses for engineers and businessmen. Part I explains the Ozalid copying process, materials, and uses; Part II consists of case histories showing how Ozalid is used in various departments and industries.

111 WELDED STEEL TUBING

Higbie Mfg. Co., Avon Tube Div.—An illustrated 12-page booklet shows the manufacture, properties, and applications of "Fusionweld" steel tubing. Sizes from $^3/_{16}$ in. OD to $^5/_8$ in. OD are listed with ultimate bursting strength and hydrostatic pressure. Special sizes are available. Tolerances and design information are included in the booklet.

112 SOCKETS AND UNIVERSAL WRENCHES

Apex Machine & Tool Co.—Catalog 29 gives dimensional and manufacturing data on a complete line of sockets, extensions, adapters, and universal wrenches. It also includes a part number index of new items and a cross index with obsolete part numbers. Drawings of all products and photographs of many are shown in the catalog's 114 pages.

113 PUMPS, MOTORS, AND ACCESSORIES

Oilgear Co.—Bulletin 10051-C illustrates and describes a line of Fluid Power pumps, motors, transmissions, cylinders, and valves. It features an expanded line of variable and constant delivery pumps for operation at higher speeds, 1-hp variable-delivery pumps, constant-delivery duplex pumps for pressures up to 5000 psi, and a larger-capacity feed pump.

114 STEAM TRAPS

Clark Mfg. Co.—Information is available on a new development in steam trap construction, called Duo-Step Leverage. By using an ingenious double-fulcrum point and venting mechanism it is now possible to increase the drainage capacity of a trap so that it may handle twice the condensate formerly possible, Clark says.

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Enco Atomizers are used with various types and makes of pulverized-coal and gas-burner units to provide a dual fuel unit for cold starting, or for full-load operation when coal or gas is not available, or use when oil is the more economical fuel.

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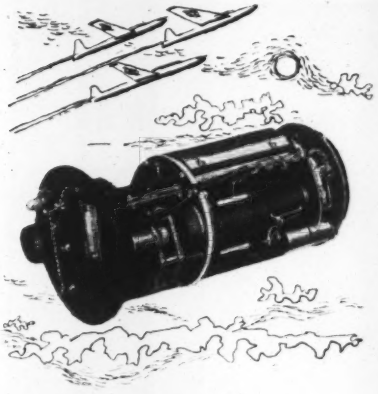

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115 PIPE LININGS

Centriline Corp.—Booklet describes cleaning and cement lining of metal pipes in place underground in sizes from 4 to 144 in. These linings increase and maintain pipe-carrying capacity, protect pipe against corrosion, and prevent leakage where pipe has been penetrated by exterior or interior corrosion.

116 GEAR AND GEAR-UNIT APPLICATIONS

Farrel-Birmingham Co., Inc.—Equipment News, Series G, deals specifically with gears and gear-unit applications as described in this 4-page bulletin which has no set publication schedule. Several fields of application are described and illustrated. Also available are catalogs on geared speed reducing units, No. 449, and geared speed-increasing units, No. 448.

117 BOILER FLUE BLOWERS

Economy Flue Cleaner Co.—Brochure describes a new flue cleaner that is described as very satisfactory on all types of fire-tube boilers. According to the manufacturer, it is only device of its kind that can operate on low-pressure boilers using a small-sized air compressor and receiver. Directions for installation are included, with photographs.

118 BAKELITE GEARS

Greaves Machine Tool Co.—New price list covers silent bakelite gears in diameters from $3^1/_2$ to $6^1/_2$ in. with faces from $2^1/_2$ to 4 in. Prompt delivery is promised for these non-metal gears, said to be capable of carrying big loads under severe corrosive conditions without being affected by heat, cold, or moisture.

119 HYDRAULIC DYNAMOMETER

Taylor Dynamometer & Machine Co. Bulletin No. 760 describes the constructional and operational features of the Taylor Hi-Eff hydraulic dynamometers. A brief summary of the range of models and capacities is included, starting with fractional horsepower units up to the very large 6000-hp units.

120 BALL BEARINGS

Nice Ball Bearing Co.—Nice Catalog No. 150 lists standard radial, thrust, and combined radial-thrust bearings of both precision and unground types, and includes several new lines recently announced. Ball bearing rollers, sheaves, wheels, and other anti friction products are included, with capacity ratings, complete specifications, and engineering data.

121 FLUID FLOW INSTRUMENTATION

Aero Research Instrument Co.—Illustrated bulletin announces the manufacture of new and improved probes for sensing gas temperature, pressure, direction, velocity, and turbulence in and about turbo jets, ram jets, and some rocket engines. These probes are claimed to be generally less expensive units with superior performance characteristics. A research lab has been set up for special problems and facilities are available for custom-built probes for specific designs.

122 GEARS AND COUPLINGS

Grant Gear Works, Inc.—Catalog describes the entire line of stock gears, speed reducers, sprockets and chains, couplings, and special gears. Spiral bound, the 176-page catalog contains 40 pages of tables and engineering information relating to power transmission.

123 STEEL TUBING

Republic Steel Corp., Steel and Tubes Div.—An 8-page bulletin lists the various types of mechanical and pressure tubing and stainless tubing, and methods used for finishing and fabricating them. In addition to design data giving chemical and mechanical properties, the pamphlet contains many illustrations of typical applications.

124 CENTER-TO-CENTER DISTANCE CALIPER

Sorenson Center-Mikes, Inc.—Bulletin 652 explains the operation of the Center-Mike, a vernier caliper which gives directly the center-to-center

For Consulting Engineers Turn to Page 156

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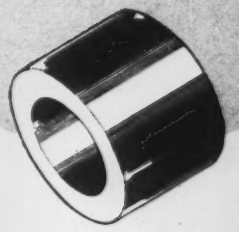

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White Cap found the answer in a standard 2½" C.D. Cone-Drive speed reducer. Over 500 of these machines—operating under lease—have proven it.

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distance between two holes, or the distance from the center of a hole to a surface. Minimum hole diameter that can be measured is 0.201 in. for the standard contact, and 0.061 in. for the supplementary contact which is available.

125 LOCK NUTS AND WASHERS

Illinois Tool Works, Shakeproof Div.—Catalog AS-46 features lock washers, pre-assembled screws and lock washers (Sems), thread-cutting screws, pre-assembled nuts and lock washers (Keps), and lock nuts (Lokuts). The locking action of Shakeproof products is explained and illustrated.

126 PRESSURE AND MECHANICAL TUBING

Ohio Seamless Tube Co.—An 8-page folder describes and illustrates typical usages of seamless or welded pressure and mechanical tubing. It includes dimension tables and examples of the special fabrications and finishes possible.

127 ANTI-ICING, HEATER, AND FUEL-SYSTEM EQUIPMENT

General Metals Corp., Adel Div.—Bulletin 173-102 describes aircraft-type, electro-driven pumps for anti-icing, fuel-boost, and cabin-heater applications. Specifications are listed and pump-performance curves included covering use of isopropyl alcohol and 100-octane gasoline. Related equipment, such as low-pressure fluid filters, and relief and solenoid shut-off valves, are also included.

128 HIGH-SPEED MOTION PICTURE CAMERAS

Wollensak Optical Co.—An 8-page pamphlet describes the operation and uses of the Fastex high-speed cameras used in research, commercial engineering, and medicine. These cameras are a continuous-moving film type with rotating prism positioned between the lens and the sprocket. They are available in 8, 16, and 35 mm, in both 100- and 400-ft.capacity and are capable of taking pictures at rates of 150 to 160,000 frames per sec.

129 AUTOMATIC CONTROLS

Mercoid Corp.—Catalog Number 700B, a 64-page reference book for engineers, contains information on automatic controls for pressure, temperature, liquid level, and mechanical movement. Transformer-relays and mercury switches are also listed.

130 ELECTRICAL PRECIPITATORS

Research Corp.—Illustrated General Bulletin, 28 pages, describes Cottrell theory, methods, types, and specific applications in a variety of industries, including power, steel, chemical, paper, metallurgical, gas, oil, and carbon black.

131 VARIABLE-SPEED DRIVES

Link-Belt Co.—The P.I.V. Variable Speed Drive, available in 8 sizes and 16 types, from ½ to 25 hp with ratios to 6:1 is featured in Book No. 2274. Selection of the right drive for a specific service may be made from 36 pages of tables on "Pre-selected Drives."

132 ELECTRIC MOTORS

Robbins & Myers, Inc.—Bulletin No. 400 describes the R & M "All-Weather" motors. These motors can be installed anywhere, in any climate: in damp areas, in dusty or corrosive environment, the manufacturer declares. There are drip-proof and splash-proof polyphase motors from 1–50 hp; single-phase, 1–7½ hp; direct current, 1–7½ hp; totally enclosed, fan-cooled, 1–40 hp; and explosion-proof, 1–40 hp.

133 MECHANICAL DUST COLLECTOR

Western Precipitation Corp.—"The Multiclone Mechanical Dust Collector," a 32-page booklet, outlines theories and basic principles of centrifugal dust recovery and describes Multiclone advantages as assuring higher recovery at lower overall costs. Multiclone's vane design and its operation with small particles as well as medium and coarser ones is explained.

134 REMOTE VALVE-CONTROL

Stow Mfg. Co.—Flexible shafting for the remote control of valves is the subject of a 16-page design manual. Inaccessible valves up to and including valves with 27 in. diameter handwheel may be controlled with flexible shafting, according to the manufacturer. Also, many valves in a plant may be controlled from one central station. A chart is given for the selection of the correct size flexible shaft for any valve. Different types of end connections are shown in detail.

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135 PLASTICS

Sparta Heat-Treat Co., Plastics Div.—A 4-page folder describes the features of Du Pont "Teflon," said to improve products, processes, and profits. This plastic is practically chemically inert, non-adhesive and can be used for a range of temperature of −320 F to 500 F. There is a table of typical properties of molded Teflon.

136 ENGINES

Briggs and Stratton Corp.—A 4-page folder illustrates and describes their line of single-cylinder, 4-cycle, air-cooled engines.

137 HEAT-TRANSFER EQUIPMENT

Trane Co.—"Extended Surface Heat Transfer Equipment," Bulletin DS-378, is available. The bulletin describes both Trane Brazed Aluminum and Trane Fin-and-Tube heat-transfer surfaces and exchangers. It gives typical applications, performance data, working temperatures and pressures, and other engineering information.

138 SILICONE RUBBER PRODUCTS

Garlock Packing Co.—An 8-page Bulletin AD-147 describing many of Garlock's silicone rubber products has been issued. The silicone rubber products described in the bulletin include: diaphragms, gasketing, sheet packing, oil seals, rings, insulation tape, rod and valve-stem packings, and molded shapes for many industrial uses. The bulletin points out the heat-resistant and aging-resistant features of silicone rubber and gives examples of typical applications.

139 DUAL-COOLED MOTORS

Reliance Electric & Engineering Co.—Bulletin C-2201 describes Reliance Dual-Cooled Motors. Separate internal and external cooling systems give continuous cooling said to be beyond that of standard open type or fan-cooled motors at all motor speeds. Cutaway view, with transparent overlay in two colors, illustrates operation and construction. Dimensions and selection data are included.

140 OIL AND GAS BURNERS

Ray Oil Burner Co.—An illustrated 16-page catalog gives specifications and capacities of commercial and industrial oil and combination gas-oil burners. It covers fully automatic, semi-automatic, and manually controlled horizontal rotary oil burners, gas burners, and combination gas-oil burners; commercial and domestic pressure-atomizing types for oil, gas, or combination gas-oil. Tables and other technical data are included to aid in selection.

141 BLOWER WHEELS

Revcor—A 32-page illustrated catalog gives tables of dimensions and performance data under test conditions of the NAFM Code of a line of single- and double-inlet blower wheels. There is also a section on sheet-metal housings to fit all their blower wheels. The catalog includes schematic diagrams and dimensions tables.

142 TOOL STEELS

Vanadium-Alloys Steel Co.—One of a series of bulletins covering specific groups of tool steels manufactured by Vanadium is offered. It gives the uses, compositions, and heat treatments of the following tool steels: Colhed, Par-Exc, Silman, Mosil, Cm, Croman, Nikro M, and Speed-Cut. The booklet also discusses pertinent metallurgical characteristics.

143 CATALYTIC COMBUSTION

Catalytic Combustion Corp.—Reprints of three articles on heat recovery and fume disposal reveal many uses for catalysts in metal working, foundry, plastics, rubber, chemical, electrical, and paint industries. "Catalytic Energy Recuperation for Industrial Process Heating" discusses new opportunities for reducing fuel costs by recovery of latent energy from exhaust vapors. "Catalytic Combustion of Core Oven Fumes" describes operating results from catalytic fume disposal on foundry core ovens. "Catalysts Eliminate Fumes, Odors and Combustible Condensate" covers essential design considerations and applications for which Catalytic Fume Combustion may be used.

144 WATER CONDITIONING DATA BOOK

Permutit Co.—Pocket-size Data Book No. 2478A was compiled for practicing engineers and those who work with water conditioning problems. It covers such subjects as hydraulics, impurities in water, chemicals used in water treatment, specific gravities, and chemical reactions. The 108 pages of data, with 78 tables of information, is bound in a leatherette cover and gold stamped.

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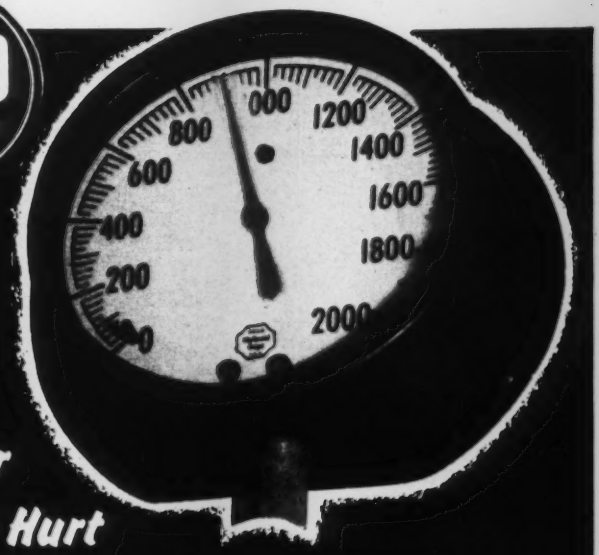

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Try a HELICOID. Find the toughest spot you have for a gage. Let the HELICOID prove itself. Let it show you how much these quality gages can save you, especially in maintenance, as the standard gage throughout your plant.

HELICOID has no gears to wear out!

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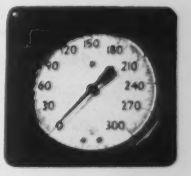

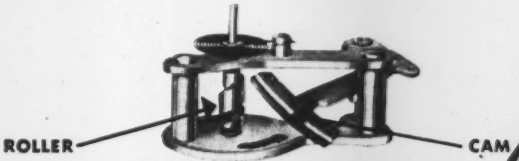

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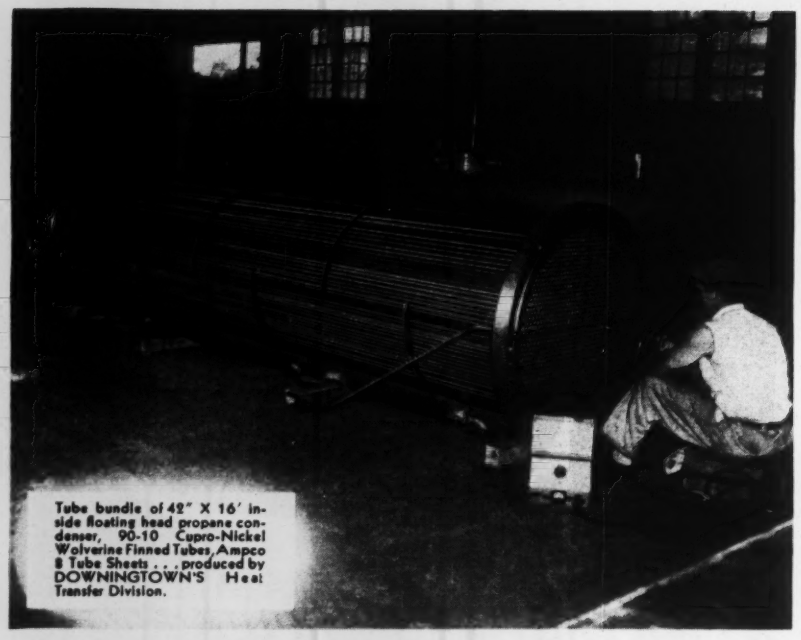

Tube bundle of 42" X 16' inside floating head propane condenser, 90-10 Cupro-Nickel Wolverine Finned Tubes, Ampco 8 Tube Sheets . . . produced by DOWNINGTOWN'S Heat Transfer Division.

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145 COUNTERPOISE PIPE HANGER

National Valve & Mfg. Co.—Bulletin 153 describes and illustrates the Navco Counterpoise Pipe Hanger used in steam generating stations, refineries, and chemical plants. Said to be the first accurate and efficient support for high-temperature piping systems, its features permit flexibility of installation, a saving in space, and a minimization of the friction problem. The Navco Counterpoise Pipe Hanger is available in 16 frame sizes with load capacity from 200 to 16,000 lb and expansion travels up to 12 in.

146 AIR-GAS COMPRESSOR

Dresser Industries, Inc., Roots-Connersville Blower Div.—A 4-page pamphlet, Bulletin SC-152, discusses the operation, features, and construction details of the Spiraxial Compressor, developed to bridge the gap between rotary positive-displacement and centrifugal lines. The company also manufactures centrifugal blowers and exhausters, rotary positive blowers, gas pumps, liquid and vacuum pumps, positive-displacement meters, and inert-gas generators.

147 SNAP RINGS AND LOCK WASHERS

Eaton Mfg. Co.—Catalog describes designs and applications of their complete line of (1) snap, bearing, lock, and retainer rings; (2) spring lock washers preassembled on bolts or screws, also self-tapping types; and (3) spring lock washers. Also included are tables of dimension specifications, and installation instructions.

148 FLEXIBLE COUPLINGS

Morse Chain Co.—Catalog C 41-48, 24 pages, includes the latest dimensional data and specifications for selection of Morse Morflex Flexible Couplings and Morse Morflex Radial Couplings. Included are drawings of special adaptations designed to solve industrial problems requiring torsional flexibility, plus torque and resilience graphs for determination of mass elastic studies.

149 OSCILLOSCOPE

Technomatic Instrument Co.—Typical applications and specifications are given in this 4-page folder of the Model 21A 21-in. cathode oscilloscope. The instrument is precision-calibrated as to time, base, and vertical gain control. Its size makes it recommended for lecture hall demonstrations.

150 LUBRICANTS

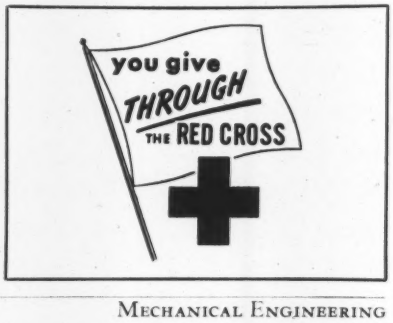
Rockwell Mfg. Co.—Bulletin No. V-220 describes lubricants, lubricant fittings, lubrication equipment and methods for Rockwell-built Nordstrom valves. Three major types of lubricant, Rockwell Hypermatic, Nordcoseal, and Lubricant DC-234, are covered, with an instruction chart showing which lubricants are recommended for use with a variety of fluids. The bulletin also illustrates and briefly describes the new Rockwell bulk and gun tube lubricants, along with stick and bulk lubricants.

151 FRACTIONAL-HORSEPOWER GEARS

Gear Specialties, Inc.—A 6-page bulletin illustrates and describes complete facilities together with different types and applications of G.S. small gears from 12 to 96 diametral pitch. Several diametral pitch and circular pitch charts included.

152 COIL SPRINGS, WIRE FORMS, AND METAL STAMPINGS

Dudek & Bock—Bulletin shows how the manufacturer's free design service can save users many dollars. Special instruments developed to take the guesswork out of specifying, inspecting, and testing are described, together with engineering charts and data in easy-to-understand language.



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153 PRESSURE-TESTING INSTRUMENTS

Crosby-Ashton Co.—Catalog 500-E illustrates and describes Ashton Dead-Weight Testers for testing to pressures of 10,000 psi, Crosby Fluid-Pressure Scales for testing to 25,000 psi, and Ashton Portable Gage Test Pumps and Inspector's Test Set for testing to 600 psi. Style 179 Dead-Weight Tester and Style CD-1 Fluid-Pressure Scale are portable instruments and are furnished in convenient carrying cases. The accuracy of these instruments ranges from 0.25 per cent to 0.1 per cent.

154 BOILER-BURNER UNIT

Titusville Iron Works Co. and Iron Fireman Mfg. Co.—These two companies have joined to produce a complete boiler-burner unit using oil, gas, or oil-and-gas combination for high-or low-pressure heating, power, and process steam. Descriptions and illustrations of the operation of the units are given as well as tables of data, ratings, and dimensions of both low-pressure and high-pressure units. Information is also included on corollary products.

155 HIGH-SPEED GEAR UNITS

Western Gear Works—Bulletin 5204-HS contains engineering data and information on gear units designed for high-speed operation, as an aid to engineers, designers, and users of mechanical power transmission equipment. Horsepower rating information, selection data, and other specifications on units designed for stepping up power from the prime mover to driven equipment is contained in this bulletin.

156 AIR-RELEASE AND AIR-INLET VALVE

Simplex Valve & Meter Co.—Bulletin 1203 describes the functions of a new Type AV Combination Air-Release and Air-Inlet Valve. This valve was designed to provide a small instrument having the functions of automatically releasing air accumulations from systems, admitting air to systems for the purpose of breaking vacuums within them, and venting large quantities of air when filling systems with water.

157 ELECTRIC MOTORS

Allis-Chalmers Mfg. Co.—Catalog 51B6052P is designed to help determine the electrical and mechanical characteristics desired in commonly used motors and to indicate availability of less frequently used types and larger motors that may solve more involved application problems.

158 BASEBOARD HEATING

Warren Webster & Co.—A 16-page illustrated catalog contains data on design features of the latest model Webster forced hot-water baseboard heating. The catalog gives ratings and dimensions; all data is based on using baseboard in perimeter-heating arrangement.

159 MOTORS AND COLLECTOR RINGS

B. A. Wesche Electric Co.—An 8-page folder gives characteristics, applications, and functions of torque and special motors, which are custom-built and can be provided in various combinations of design features. The bulletin also lists examples of custom-built collector rings as well as tables of dimensions for their standard design.

160 SPEED REDUCERS

D. O. James Gear Mfg. Co.—Herringbone-gear speed-reducers are cataloged in 60-page illustrated Catalog No. 40-C. Parallel-shaft, offset-drive, single, double, and triple reduction speed-reducers, with ratios from 2.1 to 370.1 and ratings from 0.5 hp to 5000 hp, and straight-line drive, double reduction speed-reducers, with ratios from 11.1 to 76.5:1 and ratings from 0.8 hp to 800 hp, are listed. Specifications and recommended practice for selection are included.

161 DIE STAMPING

B. Jahn Mfg. Co.—"The Story of B. Jahn Production-Proved Dies" shows a number of products and how they are produced with B. Jahn dies. Stages in the production of a variety of parts of products are photographed. The advantages of the firm's operations and its available facilities are listed.

162 POWER TRANSMISSION EQUIPMENT

Lovejoy Flexible Coupling Co.—Illustrated catalogs cover the following: Flexible Couplings, cushions changed without shutdown, no lubrication needed, 1/4 to 2500 hp. Variable-Speed Pulleys, change speed while motor is running, ratios to 3 to 1, fractional to 8 hp. Select-O-Speed Transmissions, ratios to 10 to 1, fractional to 7 1/2 hp. Universal

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Standard Snubber* designs are available, incorporating Air Cleaning, Spark Arresting, Water Separation, Waste Heat Recovery, and Surge Control Features.

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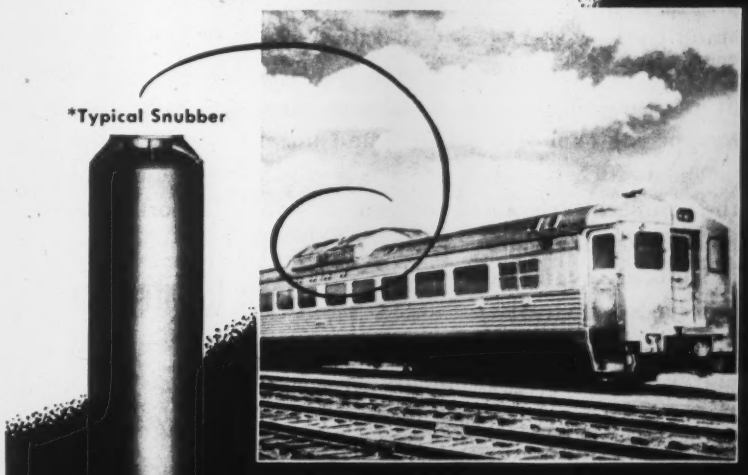
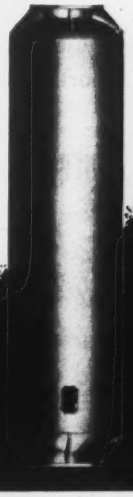


*Typical Snubber



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Joints, precision-ground alloy steel, 13 sizes, bores 1/4 to 2 in., lengths 2 to 10 3/8 in.

163 HYDRAULIC VALVE

A. W. Cash Co.—Bulletin S-600 describes in detail the new Cash Standard 4-Way Hydraulic Valve Type 555-RO. By means of sectional drawings and operating diagrams the bulletin illustrates how this new directional valve may be used to position double-acting cylinders for heavy industrial application designed for pressures from 300 to 1500 psi.

164 SWISS PRECISION SCREW MACHINE PARTS

Langendorf Watch Co.—A 20-page catalog illustrates many parts produced by this Swiss manufacturer. The parts, produced from blue prints, range from the smallest watch screw to special and shaped components up to 2.36 in., in any type of metal and finish. Also included are ordering specifications.

165 MICROHONING

Micromatic Hone Corp.—A 28-page, two-color catalog, AR-124, contains description of the Microhoning and Microflat process and equipment; specifications and work capacities of horizontal and vertical machines; representations of the range of tools, fixtures and abrasives; short explanation of automatic feeding and sizing features; and job Microhoning service facilities.

166 MERCURY CLUTCH

Automatic Steel Products Inc., Mercury Clutch Div.—An 8-page pamphlet describes the operation of the mercury clutch and its advantages over conventional clutches. A special table and photographs illustrate the many specific applications of this automatic torque control for gasoline engines and electric motors, said to eliminate many prevailing power transmission problems. The clutch is available in two series: series G for gasoline engines from 3/4 to 25 hp; series E for electric engines from 1/6 hp, 1800 rpm to 25 hp, 1800 rpm.

167 LUBRICANTS

Gulf Oil Corp.—This 4-page reprint of a widely circulated advertisement describes the practical advantages of the Gulf E.P. lubricants for enclosed gear drives. These lubricants are of the extreme-pressure type and are available for gear requirements from 55 to 1000 SUV at 210 F.

168 AIRCRAFT HYDRAULIC AND PNEUMATIC EQUIPMENT

General Metals Corp., Adel Div.—Bulletin 160-86 is an illustrated brochure describing Adel's line of aircraft accessories, together with the organization's manufacturing and environmental testing facilities.

169 RECIPROCATING ROTARY HYDRAULIC ACTUATORS

Bonnot Co.—Bulletin 21 describes and illustrates construction and operating features of a wide range of Hydromotors, trade name for reciprocating rotary actuators. Engineering data and schematic applications are included. The Hydromotor, employing air, oil, or other proper fluid medium, provides equal power in either direction and can be controlled as to speed or arc of travel. It is said to give savings in weight and space through simplification of design.

170 RUST PREVENTIVES

Rust-Oleum Corp.—Catalog 253, a new 16-page general catalog, lists industrial rust-preventive applications. Instructions for surface preparation and application of Rust-Oleum products and 73 color chips of Rust-Oleum products are contained in the catalog.

171 CRYOGENICS AND MECHANICAL CONSULTING

Arthur D. Little, Inc.—New catalog describes services and equipment for the production, handling, and storage of low-boiling liquefied gases, a high field-strength electromagnet, and other specialized equipment. The Mechanical Division of Arthur D. Little, Inc., also provides prototype-equipment development and mechanical consulting services, particularly in the areas of thermodynamics, heat transfer, refrigeration to −456 F, vacuum engineering, gas liquefaction, electromagnetism, mechanical design, vibration, and noise reduction.

172 DRIER

J. F. Pritchard & Co.—Illustrated 8-page Bulletin 16.0.081 discusses the ABC's of the Pritchard Hydryer and covers: (1) what a Hydryer is; (2) its exact functions; (3) why it should be used; (4) what it offers to users; (5) typical drying opera-

YOUR *New Catalogs* GUIDE

tions; (6) types of units manufactured; and (7) the background of Pritchard experience in the field of dehydration. In addition, this bulletin contains flow diagrams and tables for selecting the correct size Hydryer for specific drying operations.

173 GAGES

Sheffield Corp.—Catalog 126-53 has 24 pages devoted to Sheffield "Plunjet" Gaging Cartridge. Tells how to design and make your own air gaging and machine controls. Gaging ranges .001 to .040, amplification 125 to 5000 to 1. Describes a type of gaging cartridge used in conjunction with Sheffield Column and Dial Type Precisionaire Gages and other makes. Can be applied to a wide range of gaging, tooling and fixturing. Applications are shown including instructions for selecting, applying and ordering.

174 AIR-OPERATED CHUCKS AND CYLINDERS

Cushman Chuck Co.—Catalog PO-64-1953 gives complete engineering data and prices on steel and aluminum body chucks and air cylinders designed to operate without chatter at high speeds to provide low-cost, time-saving tooling on repetitive operations. It also includes reference chart, installation instructions, and schematic diagrams.

175 OIL-HARDENING STEEL

Firth Sterling Inc.—Catalog Section 20-020 describes Invaro, a "non-shrinking" type of die steel, claimed to harden deeply with a closely refined grain structure to make possible a great many high-production grinds and show almost no tendency to warpage as a result of heat treatment. The publication provides information on characteristics, annealing, drawing data, etc.

176 AIR CONDITIONER

Niagara Blower Co.—Bulletin No. 122 explains and illustrates the features, typical installations, and applications of the Niagara Type A Air Conditioner. The range of air capacity is from 1000 to 24,000 cfm and the normal temperature range is 35 to 140 F. Schematic diagrams describe the operation of the unit.

177 METERING AND PROPORTIONING PUMPS

Hills-McCanna Co.—Catalog UP-52R contains information on U-type metering and proportioning pumps, of 0.10 to 24 gal per hr per feed. Features and advantages are explained and capacities, service recommendations, and dimensions are tabulated.

178 WATER CONDITIONING EQUIPMENT

Uniflow Mfg. Co.—A 4-page illustrated folder gives the general specifications of Uniflow Industrial softeners. Included is a table giving capacities (150,000 to 950,000 grain gallons), flow rates, and general overall dimensions. A special laboratory is equipped to consider treatment of hardness, hardness compared with iron, the removal of sediment, and acid rectification.

179 ROLLER BEARINGS

Berliss Bearing Co.—Catalog No. 522, "Berliss Roller Bearings," contains a complete description and specifications of bearing selection for the materials handling, automotive, agricultural machinery, and transportation industries. It describes rollers, bearings, roller assemblies, cage and split outer race assemblies, together with bearing-selection data covering load speed factor, stationary shaft factor, and bearing life with shaft and housing limits.

180 CIRCULATION HEATERS

Edwin L. Wiegand Co.—Bulletin 701 describes and illustrates the advantages and typical applications of a line of automatic electric circulation heaters. These units are available for controlled heating of water, oils, heat-transfer media, steam, and air and other gases.

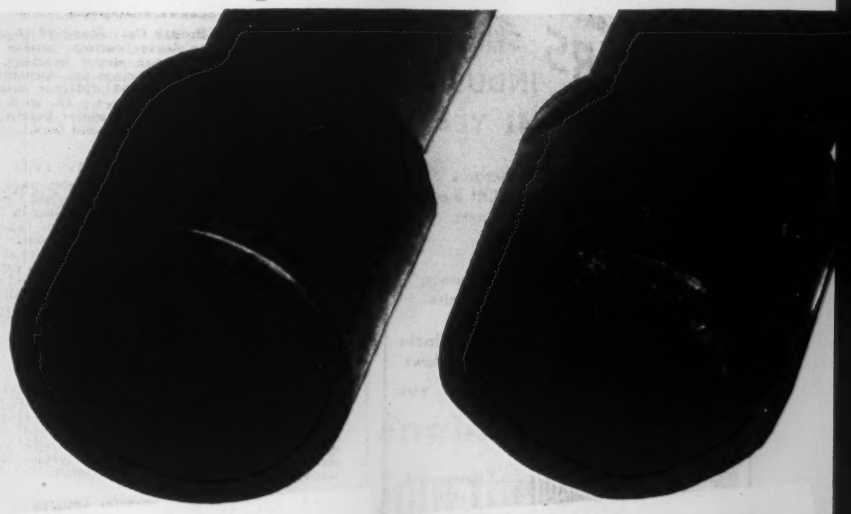
181 GEAR MOTORS

Westinghouse Electric Corp.—Folder B-5296 describes what to look for in a gearmotor. This includes a split housing, antifrication bearings, taper-hardened single-helical gears, adequate breather, positive oil seals, and ample lubrication.

182 IRON AND MANGANESE REMOVAL

Permutit Co.—Bulletin 3849 takes cognizance of the fact that iron and manganese are considered to be two of the most troublesome elements found in natural water supplies. This 8-page bulletin describes four methods of economical treatment utilizing aeration, oxidation, and ion exchange resins for the removal of these harmful water impurities.

COMPARE these Scarfing Rings used in the tip of a Gas Torch . . .



KENTANIUM Ring after 1,960 HOURS

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There's no sign of wear on the Kentanium ring and it's still on the job . . . after 1,960 hours (80 days) of service! Compare this performance with that of the super-alloy ring that had broken down from thermal shock, abrasion, and oxidation after only 162 hours . . . a better than TEN to ONE record in favor of Kentanium. This is a typical example of how industry is effectively using heat-resistant Kentanium.

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183 BRONZE SLEEVE BEARINGS

Bunting Brass & Bronze Co.—Standard stock industrial cast bronze sleeve bearings, bronze bars, electric-motor cast bronze sleeve bearings, and graphited oilless sleeve bearings are contained in Catalog 52. There are 854 different sizes of standard stock bearings, from $\frac{1}{16}$ in. to $4\frac{1}{2}$ in. ID, and 324 different electric motor bearings, as well as 263 sizes of tubular and solid bars.

184 SCREW PUMPS

Warren Steam Pump Co., Inc.—Twelve-page, two-color Bulletin S205 is devoted to Standard Gear-in-Head, High-Pressure Long-Body Gear-in-Head, and standard Vertical Gear-in-Head types of Warren-Quimby Screw Pumps. Basic construction and design are discussed in detail and there are sectional views with indicated features; also external and installation illustrations, dimensions, and specifications. Bulletin S206 includes comparable information as applied to Double External Bearing and Hopper types of Warren-Quimby Screw Pumps.

185 STEAM AND LIQUID CONTROL EQUIPMENT

O. C. Keckley Co.—Catalog No. 54 contains 60 pages of illustrations and engineering data on precision pressure regulators, temperature regulators, float valves, diaphragm valves, solenoid valves, water gages, float boxes, safety and relief valves, strainers, etc. Drawings, layout diagrams, dimensions, and capacity tables are included.

186 BALL BEARING SWIVEL JOINTS

Chiksan Co.—Catalog No. 53-C illustrates and describes complete line of over 500 different types, styles, and sizes, with data on working pressures, maximum temperatures, dimensions, and weights.

187 ELECTROSTATIC PRECIPITATORS

Koppers Co., Inc., Precipitator Dept.—Folder describes Koppers Elex electrostatic precipitators in features and performance. Specific operating results are given as well as suggested applications in nuisance elimination, cleaning of process gases, or recovery of valuable products.

188 STEEL VALVES

Wm. Powell Co.—Catalog No. 102 summarizes the broad line of Powell cast-steel valves. Included are bolted flanged bonnet valves, class 150 lb to class 2500 lb inclusive, and pressure seal valves, classes 600, 900, 1500, 2500 lb and higher. Containing more than 200 pages, the bulletin discusses the production facilities at Powell, the engineering service, large stocks in principal cities of the United States, vigilant laboratory control of metal heats, the chemical and physical properties of the various Powell cast steels, and specification data on each of a wide variety of valve classes.

189 MULTI-STAGE PUMPS

Food Machinery & Chemical Corp., Peerless Pump Div.—Bulletin No. B-1400 describes in detail and completely illustrates with technical data a complete line of 2-, 3-, 4-, and 5-stage pumps for boosting and circulating hot and cold water and clear liquids against medium and high heads. Pumps are of split-case design and are available for capacities up to 3000 gpm. Head ranges up to 1600 ft are offered, and all types of drive.

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1. Close one alarm circuit at high pressure and another at low pressure with both circuits open over operating range.
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3. To provide two-stage control by opening or closing one circuit on a rise in pressure and the second circuit on a further rise in pressure.

Ranges 0-30" to 300-2500 psi

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Every man should have a complete physical examination once a year. Women over thirty-five should have a complete physical examination twice a year. Patients are being saved today who could not have been saved even a few years ago.

The American Cancer Society asks your help.

How soon we find cancer's cause and cure depends on how soon and how much help comes from people like you.

Send contribution to Cancer, c/o your local Post Office.

Cancer strikes One in Five

STRIKE BACK...

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Can a
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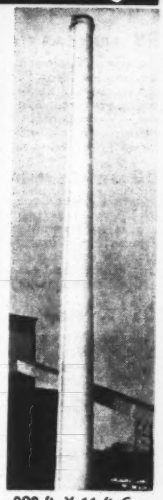

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The DENISON Engineering Co.
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190 WATER VAPOR PHYSICS

Pittsburgh Lectrodryer Corp.—Bulletin No. 218, "The Moisture in Our Atmosphere," a 12 page bulletin, discusses the fundamental physics of water vapor. The nature and behavior of water vapor are treated in a logical down-to-earth manner with psychrometric chart explanations. The use of solid adsorption equipment for dehumidification is also described.

191 BIN LEVEL INDICATOR

Bin-Dicator Co.—New 1952 catalog fully describes and illustrates bin level indicator which gives automatic control of machinery in response to fluctuating level of materials in silos, bins, hoppers, conveyers, etc. Dimensional drawings, mounting details, typical applications, wiring diagrams, and list of present users. Illustrated applications to stoker operation, flour packing, chemical proportioning, concrete mixing plant, packaging ores, salt, feed, chemicals, candy, etc.

192 GAS COMPRESSOR VALVES

J. H. H. Voss, Inc.—Bulletin 53-G covers Voss Valves for the replacement of worn or inefficient valves in air, gas, and ammonia compressors. The valves are machined from solid stock and plates are machined and ground; valves and plates are of heat-treated alloy and stainless steel, and are designed to specification to fit the individual compressor for which they are manufactured.

193 COOLING TOWERS

Water Cooling Equipment Co.—Recently revised illustrated catalog describing types of cooling towers and their outstanding design features, induced-draft systems, forced-draft systems, low-head induced-draft cooling towers, and atmospheric cooling towers is now available. The factors determining selection of water cooling towers and the engineering assistance available from WCEC are fully described. Capacity tables and physical data are included.

194 VARIABLE-SPEED DRIVES

Reliance Electric and Engineering Co.—Bulletin D-2311 describes the Reliance V-S Drive. Operating from a plant's a-c circuit, this all-electric adjustable-speed drive claims smooth, quick starts and stops, controlled acceleration and deceleration, infinite range of stepless speeds, quick reversing, jogging, inching, creeping, and centralized control, all through power directly applied to driven machines. Standard applications in various industries and auxiliary equipment for specialized applications are also presented.

195 MINIATURE BALL BEARINGS

Miniature Precision Bearings, Inc.—A 20-page, 3-color catalog, illustrated with comprehensive specifications on more than 140 types and sizes of standard miniature ball bearings from 1½ mm to ⅜ in. OD, includes material of particular interest to designers of precision mechanisms—applications, lubrication, design variations, special bearings, etc.

196 WELDING, BRAZING, STAINLESS STEELS

Republic Steel Corp.—A welding manual presents a full discussion of engineering data and operational details for welding and other methods of hot-joining stainless steels. Over 50 pages of pertinent information includes chemical analyses, mechanical and physical properties of the 300- and 400-series, classification and illustration of the various methods, and recommended data for specific operations.

197 GRATING, FLOORING, STAIR TREADS

Blaw-Knox Co.—Bulletin 2365 features the Electroforging—® process of manufacturing Blaw-Knox grating and stair treads. Illustrations, charts, and descriptive data point up the strength and permanence of Electroforged, one-piece construction of grating for industry. Two pages of this 16-page bulletin include an accurate table of safe loads, sizes, and specifications for Blaw-Knox grating and stair treads.

198 ROTARY PORTABLE COMPRESSORS

Ingersoll-Rand Co.—Four 4-page fliers, each describing one size Gyro-Flo compressor, utilize photographs, cut-away sections, diagrams, and schematic drawings. Charts show the number of tools that can be powdered by each machine. The text gives details of the rotary design and tables of weights and dimensions. Form 2314 covers the 105 cfm model; 2315-B the 210 cfm model; 2316 the 315 cfm model; and 2317 the 600 cfm model.

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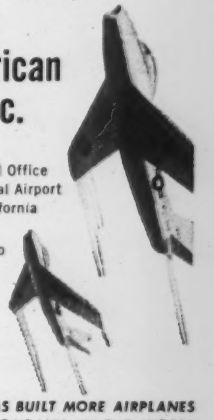

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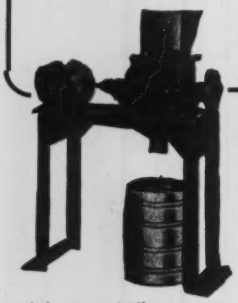
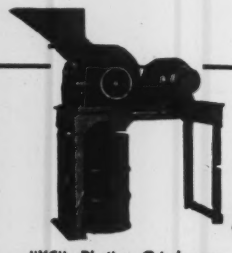
"24" Series—ring or hammer crushers. Capacities to 50 TPH.



Laboratory Mill—for testing pilot plant operation—and waste reduction.



"KC" Plastics Grinder—reduces thermoplastics sprues, rejects. Capacities to 450 lbs. per hour.

"AC" Ring Mill. With American's exclusive shredder rings—for high tonnage, uniform reduction. 500 TPH capacity.

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American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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199 NUCLEAR GAGES

Industrial Nucleonics Corp.—Vol. 1, No. 1, of "Nucleonics Views" describes the use of a beta gage to control automatically the weight of rubber coating given to cord and fabric used in automobile tires. Variations in weights are detected, the correction is calculated, adjustment is made, and the process is recorded on a chart, all automatically.

200 HEAT EXCHANGER

Niagara Blower Co.—Bulletin No. 120 describes the general construction and operation of the Niagara Aero Heat Exchanger used to cool or control the temperature of liquids or gases. The exchanger is a closed system using air as the cooling medium and transferring the heat by evaporating a water spray. Various installations are shown.

201 INVESTMENT CASTINGS

Precision Metalsmiths, Inc.—"Pour Yourself an Assembly With Investment Castings" explains the investment-casting process. Illustrations of the difficult castings that can be made by the investment-casting process and a step-by-step description of the procedures used by the company are included in the 8-page booklet.

202 INDUSTRIAL INSULATION

Armstrong Cork Co.—A 32-page illustrated booklet includes specifications for industrial low-temperature and heat insulation. It explains and illustrates insulation products and sundries, and the application of insulation materials —300 F to 2800 F. Design data, standards, and methods of construction are described.

203 SELF-CONTAINED BOILERS

Cleaver-Brooks Co.—Boiler Catalog No. AD-100 includes complete description of the Self-Contained LR Boilers for heating and processing. The catalog lists features, shows typical applications, covers design, construction, and efficiency, and contains charts on capacities and dimensions. Back cover contains complete list of sales representatives handling and servicing Cleaver-Brooks Self-Contained Boilers.

204 FORK TRUCK OPERATION

Hyster Co.—A 24-page manual for use in training lift-truck operators contains information not only about the operation of a lift truck, but also preventive maintenance, safety, and basic materials handling. Drawings are included for an obstacle course.

205 WRENCH-OPERATED CHUCKS

Cushman Chuck Co.—Catalog 65-1953 contains engineering data and prices on light-, medium-, and heavy-duty, independent, self-centering, and combination chucks recommended for engine, toolroom, manufacturing, and turret and automatic lathes. It is indexed.

206 NON-ELECTRIC MAGNETIC SEPARATORS

Eriez Mfg. Co.—Catalog 16 lists the Eriez line of non-electric permanent magnetic separators, gives their advantages, and contains tables of sizes and weights. Magnetic pipeline traps, assemblies for installation of magnets in pneumatic lines, liquid lines, and gravity flow chutes, magnetic-pulley separators, and rotary floor magnets are among the equipment listed.

207 FLEXIBLE COUPLINGS

Falk Corp.—Bulletin 4100-1953 consolidates information about all types of Steelflex couplings by Falk. A foldout bound into the middle of the book explains the Steelflex design, and the rest of the book is devoted to technical data for use in selecting the proper coupling for different applications, whether it is the standard Type F or a special or dual-purpose coupling.

208 GATE VALVES

Darling Valve & Mfg. Co.—Bulletin 5006SLS covers Darling's parallel-seat, fully revolving, double-disk gate valves of cast iron, cast steel, or all bronze. Advantages and construction features are discussed and illustrated in the 4-page leaflet.

209 SPIRAL CONVEYERS

Jeffrey Mfg. Co.—Catalog 851 describes and illustrates the complete line of Jeffrey Spiral Conveyers and Fittings fabricated in accordance with new industrial standards, making them interchangeable for replacement service. Booklet includes capacity tables, dimension tables, selection tables, and index of products. It covers six principal types of conveyers: Sectional Flight, Helicoid, Mixer, Cut Flight, Ribbon, and Cast Iron.

YOUR *New Catalogs* GUIDE

210 INDUCTION HEATING

Ohio Crankshaft Co., Tocco Div.—New catalog 22, 20 pages, describes the principles, applications, and equipment of Tocco induction heating. Typical results of induction hardening and heat-treating, and results of induction heating for forming and forging are given.

211 FLOW METERS

Foxboro Co.—Bulletin 460 describes basic flow meter advances and introduces six meter types for sustained accuracy in fluid flow measurement. Bulletin 465 on "Circular Case Automatic Controllers" and Bulletin 461 on "Automatic Controllers" cover other recent developments in Foxboro's line of pneumatic, electric, and electronic instruments for indicating, recording, and controlling industrial process variables.

212 FULLY CROWNED GEAR TEETH

American Flexible Coupling Co.—Seven major engineering advantages of fully crowned teeth in gear-type flexible couplings are described in a new Bulletin No. 1052. Excessive offset or angular misalignment, space limitation, high speeds, and torque loads are problems described and illustrated.

213 BEARINGS

Gwilliam Co.—Sectional illustrations and tabular data of standard bearings carried in stock, and special bearings are described in Catalog No. 28. Ball, roller, and journal bearings are listed.

214 FUEL-HANDLING SYSTEMS

Fairfield Engineering Co.—Four-page folder gives illustrations of typical coal and ash systems for power plants already installed. The systems are said to cut fuel-handling labor costs, thereby reducing operating costs. Also described is a plan of one-source responsibility for power plant modernization.

215 INSTRUMENTS AND RECORDERS

Brush Electronics Co.—Brush oscillographs, amplifiers, acoustical instruments, and recording analyzers provide usable, permanent records on electrical, mechanical, or acoustical investigations on items such as surface finish, textile fiber uniformity, d-c or a-c voltages or currents, strains, displacements, light intensities, temperatures, and other static or dynamic conditions.

216 HEAT EXCHANGERS

Pressed Steel Tank Co., Downingtown Iron Works, Inc., Div.—Catalog contains details of heat-exchanger section, performance, mechanical design, tube-sheet layout with tables, illustrations, etc. A partial analysis of ASME code for unfired pressure vessels is included.

217 METERS AND CONTROLS

Bailey Meter Co.—A comprehensive catalog, Bulletin 18, offers information on the complete line of meters, control equipment, and engineering services by Bailey Meter Co. It is written for engineers in power plants, public utilities, and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, illustrations, and detailed literature references are included.

218 ROTOR VANES

National Carbon Co.—Catalog Section S-5430, "'National' Carbon Rotor Vanes," describes the unique advantages of carbon as a rotor-vane material in sliding-vane-type rotary pumps and compressors.

Fill in and Mail the coupon on page 42 without delay.

Standardaire® Blowers

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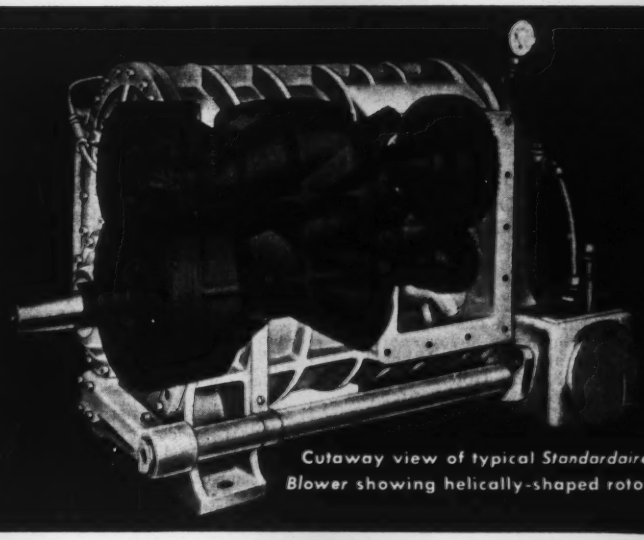

Cutaway view of typical *Standardaire Blower* showing helically-shaped rotors.

As the *Standardaire Blower's* unique helically-shaped rotors revolve, pockets are formed at the intake port which diminish in size as they approach the point of discharge. Within these pockets, air is compressed gradually and smoothly. The internal pressure is raised approximately to the discharge pressure before the pocket registers with the discharge port . . . reducing noise, shock, and loading of internal parts.

Since high pressure air is confined to the discharge end of the *Standardaire Blower*, leakage lines are much shorter than on other types of units. The rotors are accurately machined to very close running clearances and provide a continuous sealing for the entire length of their engagement. Their perimetral edges are sealed by the housing.

These are but a few of the unique features of *Standardaire Blowers* . . . which result in very high volumetric efficiency at lower installed cost, and lower maintenance and operating costs.

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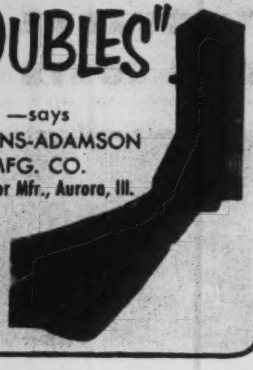
Conveyor Mfr., Aurora, Ill.



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LATEST INDUSTRIAL LITERATURE

219 BALL BEARINGS

Marlin-Rockwell Corp.—Bulletin No. 26 contains a list of bearing numbers of over 14,000 different ball bearings made by the various American ball bearing manufacturers. The bearing numbers for each manufacturer are arranged numerically, so that any particular number can be readily found. MRC replacement number for each is given.

220 WATER-TUBE BOILERS

Henry Vogt Machine Co.—A 16-page bulletin describes Class VF and Class VS 2-drum bent-tube boilers. Photos and line drawings with design data illustrate typical units as installed in various industries.

221 TOOL-DIE AND SPECIALTY STEELS

Jessop Steel Co.—A 60-page catalog gives applications and working data for Jessop high-speed steels, hot-work tool steels, cold-work tool steels, shock-resisting tool steels, carbon and low-alloy tool steels, and saw steels. A section on steels for special applications is also included.

222 FIRE EXTINGUISHING

Grinnell Co., Inc.—More effective control of fire, with less water, for a wide variety of hazards is described in "Grinnell Automatic ProtectoSpray," which explains a new coordinated three-way attack upon fire. It has special value for fire hazards involving high-piled storage, rubber, flammable liquids, paints, and flash-fire materials.

223 CORROSION-RESISTANT FASTENERS

H. M. Harper Co.—Corrosion-resistant fastenings designed to meet any requirement are listed and illustrated in Catalog 25. Current prices, sizes, and shipping data are included for bolts, nuts, screws, washers, rivets, and cotter pins of nonferrous metals and all stainless steels.

224 ALUMINUM IMPACT EXTRUSION

Aluminum Co. of America—"Alcoa Aluminum Impact Extrusions" describes the impact extrusion process and its applications. Factors affecting design, tolerances, machining, standard diameters and sizes, and special finishes and wall thicknesses are contained in the booklet, as well as illustrations of a variety of products.

225 FILTERS

Cuno Engineering Corp.—A 6-page Bulletin No. PJL-1052 (formerly 1148-PJI.) gives complete data on Cuno Auto-Klean filters—edge filtration plus positive mechanical cleaning; Cuno Flo-Klean filters—backwash filter cleaning with no loss of fluid; Cuno Micro-Klean filters—replaceable element micronic filters. Description of models for industrial filtration installations are included.

226 SPEED REDUCERS AND GEAR MOTORS

Abart Gear & Machine Co.—A pocket-size catalog of Abart speed reducers and right-angle gear motors, 96 pages, gives complete engineering data on how to select the proper speed reducer to fit requirements, including horsepower ratings, ratios, and installation graphs.

227 STEAM GENERATORS

Union Iron Works—The General Catalog No. 153, 20 pages, contains typical installation drawings and condensed data on all types of Union Steam Generators and allied equipment. Also included is a section on Dowtherm Generators.

228 FANS AND BLOWERS

Chelsea Fan & Blower Co., Inc.—A 20-page Catalog No. 500 describes the comprehensive line of ventilation equipment for industry, farm, and home. Detailed specifications on all fans are included. For attic fans, recommendations for installation can be found on the respective pages. A 4-page Bulletin No. 450 is available describing in detail the selection and installation of the proper fan in industry and home.

229 SLEEVE-TYPE BEARINGS AND BUSHINGS

Cleveland Graphite Bronze Co., Div. of Clevite Corp.—A condensed 12-page catalog, "Presenting Bearings and Bushings," illustrates the range and variety of products manufactured in the world's largest bearing plant. Bushings, thrust bearings, heavy-wall bearings, main and connecting rod bearings, aircraft engine bearings, and cam-shaft bearings are described and pictured. Also included is description of research and development work, and material analyses for 19 bearing alloys.

230 DRAFTING ROOM EQUIPMENT

Hamilton Mfg. Co.—Catalog No. 13-S, revised in 1953, lists steel and wood drawing tables and files for every drafting room need. It includes comprehensive data on the Auto-Shift drafting table, and information about the shallow-drawer unit with tracing lifter.

231 TECHNICAL BOOKS

Lefax Publishers—Over 2000 listings of Lefax pocket-size technical books are contained in the newly revised 1953 Lefax list of technical data sheets. Condensed, mathematically accurate source materials for engineers, construction men, technical workers, and technical students. Each book consists of approximately 140 pages of easily read tables and data in pocket-size, loose-leaf form for handy reference right on the job.

232 VIBRATORY MATERIALS HANDLING EQUIPMENT

Syntron Co.—Catalog No. 534, 52 pages, illustrates and describes complete line of equipment, including bin vibrators, vibratory feeders, weighing and batching feeders, long conveyers, shaft seals, and power tools.

233 FORGINGS

United States Steel Corp.—A 28-page booklet "USS Quality Forgings Fully Prepared to Do the Tougher Job," illustrates and describes the forging of generator, turbine, and waterwheel forgings, anvil bases and columns, forged shafts, forged steel rolls and sleeves, and forged blooms, billets, and rounds. The booklet closes with a brief history of forging.

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New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

234 FASTENERS

Townsend Co.—A 12-page brochure of information, TL-68, covers cold-forming all types of metal fasteners, gadgets, locknuts, Cherry blind rivets, and twinfast wood screws, plus a resume of design services available.

235 SILICONES

Dow Corning Corp.—"A Reference Guide to Dow Corning Silicone Products" is a new general catalog which lists over 50 different Dow Corning Silicones according to their physical form and applications. Important properties for each product and code numbers for obtaining more information about any particular product are presented in this 4-page bulletin.

236 THREAD INSERTS

Heli-Coil Corp.—Design and engineering data on the complete line of Heli-Coil screw thread inserts—for the protection and repair of tapped threads in all materials—is contained in a 24-page, 2-color catalog, No. 652. Covered are drilling and tapping recommendations, installation procedures, and specifications for classes, 3, 3B, 2, and 2B thread fits.

237 CHIMNEYS AND STACKS

Consolidated Chimney Co.—Booklet describes and illustrates the features and installations of Consolidated chimneys, including brick, reinforced concrete, and steel stack. It also covers design data, detail diagram of lining, and vent lightning protection specification, and standard specifications for radial-brick and reinforced-concrete chimneys.

238 WATER POWER EQUIPMENT

Newport News Shipbuilding & Dry Dock Co.—A 75-page, 2-color booklet describes and illustrates 40 hydraulic-power developments and some of the equipment furnished by the company. Details of the developments and other engineering information regarding their building and operation is included.

239 VARIABLE-DELIVERY FEED PUMP

Oilgear Co.—A new 8-page Bulletin 44200 illustrates and describes their new Fluid-Power Variable-Delivery Feed Pump. Advantages claimed are simple, compact, electro-hydraulic control; easy to apply nearby or remote; quick and positive action; and automatic pressure compensation. Fine and coarse feeds are adjustable over a 20:1 range. Variable ratios from 13:1 to 256:1 are provided between feeding and rapid traverse speeds. Only two pipe lines are required.

240 ROLLER CONVEYERS

E. W. Buschman Co.—The 16-page illustrated Catalog No. 60 shows a variety of roller conveyer types, with selection data and diagrams. Seven types of ball-bearing rollers are described as well as roller mounting specifications, curves, multiple rows, spurs, converging and hinged sections, stands, and guard rails. Conveyers are shown in use in various industries.

241 O-RINGS AND BACK-UP RINGS

United States Gasket Co.—An 8-page Bulletin No. OB-1152, describes the line of Chemiseal Synthetic-Rubber O-Rings and Chem-o-green (Teflon) Back-Up Rings for military and commercial hydraulic requirements. Complete information on application is given and product data is tabulated under both commercial and AN dash numbers for references.

242 STEEL BARS

La Salle Steel Co.—Illustrated booklet gives features, applications, and physical properties on Stressproof, severely cold-worked, furnace-treated steel bars. It is recommended in many cases to eliminate the necessity for heat-treating and case-carburizing or to minimize warpage. Stressproof is said to increase machining rates, and by selective hardening to afford core strength and hard surface.

243 PIPING DESIGN

Blaw-Knox Construction Co., Power Piping Div.—The design of piping for flexibility with Flex-Anal Charts is covered in an 86-page book. It fills the need for the flexibility analysis of any piping system. It is intended for the experienced pipe designer who can, by use of this method and the application of Flex-Anal Charts, accurately analyze most piping systems in a few hours which formerly required days and even weeks. Many tables, Flex-Anal Charts, and typical piping layouts are included.

244 SURFACE ROUGHNESS

Micrometrical Mfg. Co.—A 24-page catalog of Profilometer equipment for shop measurement of surface roughness describes Amplimeter, Tracers, manual and motor-driven piloting equipment, and items in development, and includes specifications, prices, and photos of equipment in use. Lists of typical combinations of Profilometer equipment commonly selected for various job requirements are presented.

245 OFFICE COPY MACHINE

General Aniline & Film Corp., Ozalid Div.—A 4-page illustrated pamphlet features the new Ozalid Bambino, a fast, inexpensive, and compact copy machine for use on correspondence, accounting reports, purchase orders, invoices, and other administrative paper work. Pictures illustrate the operation of this machine and specifications describe its dimensions and capacities.

246 SEPARATOR FILTERS

Jas. A. Murphy & Co., Inc.—The Murphy ASF Aftercooler separator filter combination complete with zip trap is designed to do a complete job of cooling, cleaning, and drying compressed air before it enters the distributing lines; ASME designed and stamped, in sizes 50 to 2500 cfm.

247 SHAFT-MOUNTED SPEED REDUCERS

American Pulley Co.—The "Shaft-King" shaft-mounted speed-reduction units are illustrated and described in a 20-page speed-reduction drive catalog. Complete information is included on dimensions of units, where they are used, and how they are installed, with instructions on how to select the correct size unit for a given application.

248 OIL AND OIL-GAS BURNERS

Petro—New 20-page Catalog 3048 covers all types and sizes of Petro commercial-industrial rotary cup oil burners, combination oil-gas burners, and multi-belt driven pumps for heavy industrial oils; includes illustrations, descriptions, detailed construction features, wiring and piping diagrams, burner rating tables, and data on controls.

249 FLEXIBLE COUPLINGS

Poole Foundry & Machine Co.—Catalog No. 53 describes all the types and sizes of flexible couplings which they manufacture. Complete engineering data, horsepower ranges, shaft sizes, etc., are included. Several new-type disengaging couplings and the new NEMA standards are incorporated in this issue.

250 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-225 contains illustrations, descriptions and engineering data on grating-flooring, treads, and floor armoring (riveted, press-locked, welded types) for industrial, power and refinery walkways, stairways, driveways, trucking aisles; ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring expansion joints, catch basin covers; bridge decking.

251 PACKING SEALS

Victor Mfg. & Gasket Co.—Catalog No. 700 gives technical and ordering specifications for a line of synthetic-rubber sealing elements known as Victoprene.; These products are used in metal-encased oil seals and for packings. Other compounds developed for specific service conditions are available on special order.

252 NON-SEGREGATED-CARBIDE TOOL STEEL

Latrobe Steel Co.—A 12-page booklet, "Your Tooling and 'Desegatized' Steels," discusses carbide segregation in tool steel and its effects. The qualities and advantages of Latrobe's "Desegatized" steels, with uniform dispersal of carbides, are explained. The booklet is illustrated with cartoons.

253 BLADELESS SEWAGE AND TRASH-PUMP

Fairbanks, Morse & Co.—Bulletin 5400K-1 describes the new Fairbanks-Morse bladeless sewage and trash pump, utilizing a single-passage bladeless impeller. Cutaway views and descriptive text explain the details of construction of the pump, both horizontal- and vertical-shaft models. Dimensions, specifications, and characteristics are given.

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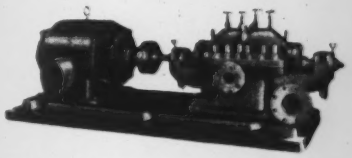
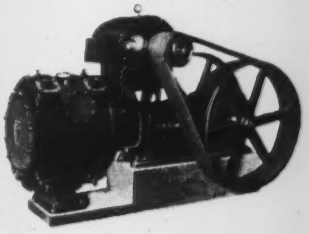
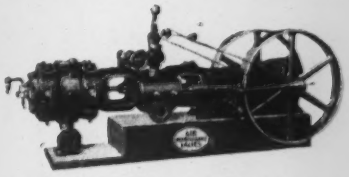


PENNSYLVANIA 4-Stage THRUSTFRE Centrifugal Pump for Boiler Feeding, General Power Plant and Industrial Use.
Bulletin 237-1



PENNSYLVANIA Class 7-AT Motor-driven Dry Vacuum Pump available in capacities ranging from 181 cfm to 2,830 cfm piston displacement. Bulletin 191-1



PENNSYLVANIA Class 4-AT Steam-driven Single-Stage, Horizontal, Water-Cooled, Roller Bearing Air Compressor.
Bulletin 185-1

YOUR Copy of Catalog 546 briefly describes ALL PENNSYLVANIA Products
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You can get POWER at almost no cost!

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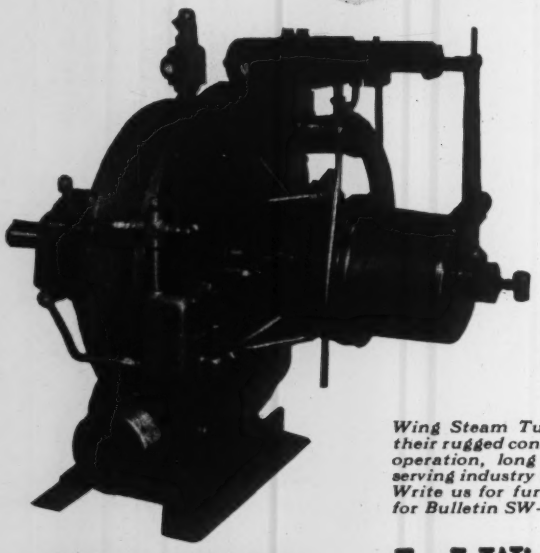

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Horsepowers to 150 b.h.p.

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Wing Steam Turbines are known for their rugged construction, trouble-free operation, long life. They have been serving industry for over a half-century. Write us for further information. Ask for Bulletin SW-1a.

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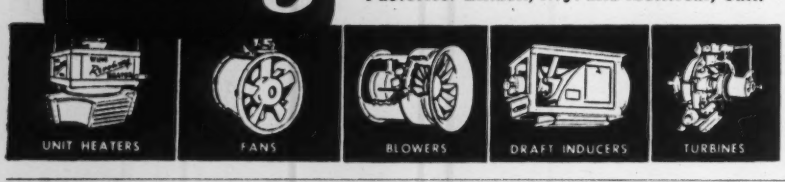

YOUR *New Catalogs* GUIDE

254 ELECTRICALLY OPERATED VALVES

Ruggles-Klingemann Mfg. Co.—Catalog E on Electrically Operated Valves will be reprinted within a few months with both revisions and additions. The company also manufactures damper and fan engine regulators, adjustable-fulcrum balance valves, chronometer valves, turbine bleeder check, relief, and reducing valves, solenoid, thrustor, and motor operated valves, and special regulating devices.

255 STAMPED GEARS

Winzeler Mfg. & Tool Co.—A 4-page illustrated booklet gives gear data and specifications including tables of tooth parts, calculation of diametral pitch, and dimensional listings. It describes the stock line of gears and pinions and describes the facilities available for custom orders on gears, precision tools, dies, fixtures, and gages. Capacity of punch press equipment is from 6 to 100 tons.

256 COOLANT PUMPS

Ruthman Machinery Co.—General information, outstanding features, pipe friction chart, and cross-section prints of Gusher coolant pumps are given in a 66-page catalog. Covered are immersed type, pipe-connected type, flange-mounted external-discharge type, and flange-mounted internal-discharge type motor-drive pumps. Shaft and pulley-driven pumps and mounting brackets and tanks are also included.

257 ELECTRIC HOISTS

Shepard Niles Crane & Hoist Corp.—Bulletin 182 gives engineering and manufacturing data on a line of light-weight Liftabout-Jr. electric hoists designed for intermittent duty. This impact planetary-gear, wire-rope-type hoist can be furnished either parallel or cross-mounted with bolt, hook, or trolley suspension and with capacities from 250 to 2000 lb. Speeds vary from 12 to 25 ft per min d-c, and 20–37 ft per min on a-c units. Additional features include dust- and moisture-proof enclosures with anti-friction bearings, oil bath lubrication, and control mountings.

258 OIL FILTERS, STRAINERS, OILING DEVICES

Wm. W. Nugent & Co., Inc.—Seven bulletins: No. 6 illustrates and describes Nugent pressure strainers; No. 7, gravity filters; No. 7A, pressure filters; No. 8, tanks, pumps, shaft oilers; No. 14, oiling and filtering systems for turbines, paper mills, steel mills, pumps, compressors; No. 15, oiling devices; No. 16, sight feed valves, multiple oilers, flow indicators, sight overflows, and compression union fittings.

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YOUR *New Catalogs* GUIDE

259 O-RING SEALS

Goshen Rubber Co., Inc.—Catalog C, 28 pages, contains tabulated data, including standard dimensions, for AN6227 and AN6230 O-ring packings and gaskets, complete installation dimensional recommendations, and guide of material compounds for commercial applications. Engineering drawings illustrate various installations.

260 WATER CHILLER

Servel, Inc.—Information about the application and flexibility of the Servel 25-ton Water Chiller for air conditioning, process cooling, and industrial precooling which solves cooling problems with waste heat or low-cost steam is described.

261 STAINLESS STEEL

Sharon Steel Corp.—A 12-page illustrated booklet describes Sharon 430 stainless steel, an all-purpose stainless steel. Chemical analysis, typical mechanical properties, and physical properties are given, and fabricating characteristics are discussed. A list of typical applications is appended.

262 VALVES

DeZurik Shower Co.—Catalog describes the line of plug valves and contains an extensive list of recommendations of materials for specific fluids, solutions, suspensions, etc. Advantages of DeZurik valves, including the cylinder-operated valve-positioner, are explained. Specifications for pipe-line strainers, gate valves, and cast-steel globe and angle valves are included.

263 FLEXIBLE METAL HOSE

Flexonics Corp.—A 32-page illustrated Catalog CMH-130 on all types of Chicago Metal Hose covers the full range of the company's Rex-Weld corrugated flexible metal hose, Rex-Tube convoluted-hose types, and Rex-Flex stainless-steel flexible metal hose. Complete specification data are given. Also covered are coupling types, special assemblies, and installation information.

264 NON-ABSORBENT INSULATION

Insul-Mastic Corp. of America—A 32-page catalog describes a protective coating and insulation combined. It is spray applied in coating form 1/8 in. thick. It is said to stop 65 per cent of heat loss, control condensation, and prevent corrosion by repelling moisture. Temperature range −40 F to 300 F.

265 ALLOY WELDING FITTINGS

Key Co.—Bulletin K.S. describes and pictures a new line of alloy welding fittings, which claims greater wall thickness throughout for increased structural strength and extra thickness at critical areas for greater allowance against erosion and corrosion. Advantages of this principle for alloy piping systems are explained graphically and alloys which will be available are listed.

266 PRESSURE GAGES

American Chain & Cable Co., Helicoid Gage Div.—The 16-page Helicoid gage catalog describes the Helicoid gage as guaranteed accurate to within 1/2 of 1 per cent of the total dial graduation over the upper 95 per cent of the 270-deg dial arc. Cutaway photographs and line drawings show the complete line of Helicoid gages.

267 FORK-LIFT TRUCKS

Clark Equipment Co.—"Material Handling News," an external house organ of the Clark Equipment Co., is featuring the X-70, an experimental model fork truck incorporating many suggestions of fork-truck users. A self-mailer questionnaire is included in the magazine as a sounding board for future design techniques. Also covered is their entire line of fork lift trucks, hand trucks, and industrial towing tractors.

268 SLEEVE BEARINGS

Johnson Bronze Co.—A series of sleeve bearing data sheets discusses such subjects as powder metallurgy, lubrication, conformability, clearances, standard tests, load-carrying capacity, corrosion, and alloys, and their consideration in sleeve bearings. Special sleeve bearings are included on the sheets.

Carrying meats, vegetables and groceries past the cash register to the wrapping clerk, at 18 ft. per minute, check-stand conveyors send super market shoppers quickly on their way in Dillon's 25 Kansas food stores.

Depended on to turn each of the grocery-laden belts at correct speed is a Winsmith Speed Reducer, special assembly Model 2B, with a reduction ratio of 48:1. "...the only reducer which would fit in the limited space beneath the check-out counter and give proper operation," states J. S. Dillon and Sons Food Stores Co., Inc.

Compactness, coupled with ruggedness and dependability, have made Winsmith Speed Reducers essential components of numerous types and makes of essential equipment. Worm, helical and differential units are promptly available within the range of 1/100 to 85 hp in 1.1:1 to 50,000:1 reduction ratios.

Request catalog 148 for details.

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Significant advancements in the fields of airborne radar and fire control systems are requiring further applications of electro-mechanical techniques in the Hughes Radar Laboratory.

The company

Hughes Research and Development Laboratories, located in Southern California, form one of the nation's leading electronics organizations. The Laboratories are presently engaged in the development of advanced electronic systems and devices which are produced by the Hughes manufacturing divisions.

Areas of work

The work calls for devising reliable, maintainable, manufacturable designs for precision equipment developed in the Hughes Radar Laboratory. The equipment consists of mechanical, electronic and microwave devices and systems to be manufactured in quantity. The equipment designs require the use of such advanced techniques as subminiaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and specifications is useful.

The future

Engineers experienced in the field of electro-mechanical design for production or those interested in entering this field will find outlets for their abilities and imagination in these activity areas. New electro-mechanical techniques are opening new applications for airborne electronic equipment. Hughes engineers will have the full benefit of working experience in these fundamental developments.

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Address resume to | **Scientific and Engineering Staff**

Hughes

Research and Development Laboratories

Culver City, Los Angeles County, California

YOUR New Catalogs GUIDE

269 SCALE AND CORROSION CONTROL

D. W. Haering & Co., Inc.—"Solution to Your Problem of Scale and Corrosion Control" catalogs the application of Haering H—O—H Glucosates to problems of scale and corrosion in water-using equipment. The booklet tells the particular use each glucosate has in correction and control of scale-formation and corrosion.

270 AIR MOTORS

Bellows Co.—Bulletin CL-30 describes and illustrates the Bellows air motor, the air cylinder with built-in valve and speed control regulators. Thirty pages of case-history photographs, diagrams, wiring circuits, technical data, and dimensional information are given, and descriptions of other Bellows "control-air-power" devices are included.

271 ELEVATED STEEL TANKS

W. E. Caldwell Co.—The Revised Bulletin ES-55 with illustrations and technical data on elevated steel tanks of standard and special designs contains complete information on tanks for town water supply, fire protection, industrial and institutional installations, and private water systems.

272 INSULATED PIPING SYSTEMS

Ric-Wil Co.—A 4-page folder Form 5205 describes briefly the complete line of products: prefabricated insulated piping for underground or overhead distribution of steam, oil, hot or chilled water, process liquids; large-diameter prefabricated Utilidor conduits for housing all utility services; prefabricated manholes; and various related equipment including conduit- and pipe-testing caps, insulation fittings for 90-deg elbows, unloading slings, and corrosion-resistant phenolic-resin coatings.

273 INDUSTRIAL SPRAY NOZZLES

Spraying Systems Co.—Catalog No. 24, a new spray nozzle catalog, contains capacity and spray characteristic data. Said to be the most complete industrial spray nozzle catalog ever produced, it illustrates nozzles for producing hollow cone, full cone, flat, solid stream, and pneumatically atomized sprays. Nozzles made of special materials are also illustrated with capacity tabulations, such as nozzles with wearing points reinforced with tungsten carbide.

274 PROTECTIVE COATINGS

Pittsburgh Coke & Chemical Co.—A new booklet on Pitt Chem Cold Applied Tar Base Coatings describes the properties of the four types of coatings manufactured by the company and gives application directions. A full-page chart lists a comprehensive selection of typical structures and corrosive agents and recommends the coatings best-suited for each application.

275 GAGES AND THERMOMETERS

Marsh Instrument Co.—Catalog No. 76-G describes in detail a wide line of industrial gages and thermometers. The catalog is fully illustrated, including cut-away photographs and enlargements of internal parts. It covers also gage accessories, specifications including line drawings and dimensional tables, and templates covering every size and pattern.

276 DISC-TYPE ELECTRIC MOTORS

Howell Electric Motors Co.—Howell Disc-Type Motors, offering length reductions from 41.7 to 50.5 per cent under that of conventional motors of the same horsepower, depending on horsepower, are described in a new technical bulletin. Sizes range from 1/4 to 20 hp at 1800 rpm, in open or enclosed types, with a variety of designs, mountings, and frame sizes.

277 INSTRUMENT BALL BEARINGS

New Hampshire Ball Bearings, Inc.—Catalog No. 53 describes the Micro precision instrument ball bearings, in sizes from 1/2 in OD to 0.0250 in. bore. Tolerances are ABEC 5 or better. Chrome and stainless steel and beryllium copper are used. A variety of types are available, specifications for each of which are contained in the catalog.

278 INDUSTRIAL INSULATIONS

Johns-Manville—A 40-page catalog, Brochure GI-6A, with descriptions, uses, and sizes of the principal products in the J-M industrial line. It illustrates and describes various types of J-M industrial insulations, and also serves as a reference catalog for information on J-M asbestos-cement pipes, friction materials, electrical materials, packings, flooring, and roofing.

YOUR

New Catalogs GUIDE

279 O-RINGS

National Motor Bearing Co., Inc.—This National O-Ring Catalog is designed for broadest usefulness in all types of O-ring applications. Includes practical working information about O-ring applications, sizes, groove dimensions, back-up rings, and dust seals, and lists all National O-Rings and local National Motor Bearing offices.

280 CONVEYERS

Mathews Conveyer Co.—Catalog 151, 68 pages of design details and illustrations, covers roller and wheel conveyers. A complete line of high-quality rollers ranging in diameter from 1 in. to 6½ in. and in capacities from 50 to 16,000 lb is shown in convenient sequence. Wheel conveyers are described and illustrated.

281 RECORDING COUNTER

Streeter-Amet Co.—A recording counter adaptable for many applications: counting electrical impulses, time intervals, revolutions, etc. Numerical totals are printed automatically on standard roll tape. The counter is capable of 1000 counters per min., 1/100 of a minute in units of time, and up to 2000 rpm, and can be furnished to count during printing operation, or to cut out counting circuit during printing. A wide variety of timing and printing mechanisms are available as standard equipment.

282 FLEXIBLE METAL HOSE

Atlantic Metal Hose Co., Inc.—An 8-page catalog, No. 500, provides the latest data on Atlantic flexible metal hose. Interlocking and seamless types are covered. Complete applications are given. Of value are a Navy test table for bronze and steel hose; data on bending diameters and hydrostatic bursting pressure; and a series of installation diagrams.

283 INVESTMENT CASTINGS

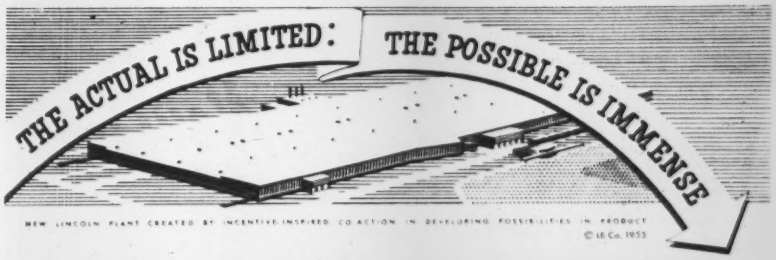
Engineered Precision Casting Co.—Investment castings, how they are cast in all metals, the process of manufacture and the precision to which they can be cast are covered in detail in this 8-page brochure. A variety of examples of intricate cast parts produced in such metals as stainless steel is shown. The manufacturing process is described and illustrated.

284 CHECK VALVE

Waterman Engineering Co.—A new check valve for use in oil, air, and water, with working pressures to 3000 psi, and featuring one-piece aluminum-body construction with a nylon poppet, is described in an illustrated circular. This check valve is available in ⅜ in., ½ in., ¾ in., and 1 in. pipe sizes.

285 PUMPS

Aldrich Pump Co.—Catalog on reciprocating pumps, 10 to 2400 hp, includes data on direct flow pumps, 3, 5, 6-in-stroke series, 10 to 900 hp (3, 5, 7, and 9-plunger units); on Aldrich-Groff controllable capacity "Powr-Savr" pumps (5 to 125 hp); and on inverted vertical pumps, up to 2400 hp, 7 in. through 8½-in-stroke sizes.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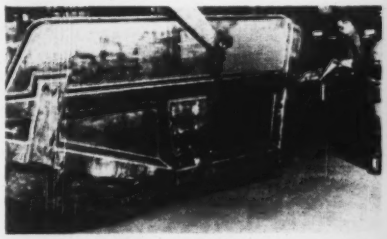

▲ **Fig. 1. Welding Manhours 60% Less** *on side frame for earth mover assembly. With "Manual Lincolnweld", sides are finished in 16 manhours . . . formerly took 40 manhours, a 60% saving in time. Each side requires 174 feet of welding.*

Fig. 2. Simpler to Set Up. *Components for side frame are tacked in position and welded with "Manual Lincolnweld". Joints too steep for "hidden-arc" welding are welded with coated electrodes.* ▶

MANUAL LINCOLNWELD CUTS WELDING TIME 50%

"HIDDEN-ARC" welding using "Manual Lincolnweld" is cutting welding time 50% and more on many components for Gar Wood earth movers. On some jobs, overall welding time has been reduced as much as 67% because of less warpage, lower set-up time and greater freedom from weld spatter.

Strength and quality of welds produced with "Manual Lincolnweld" are equal to fully automatic welding. Setup time, however, is less since the work can be welded in the tacking position, and the welding gun of "Manual Lincolnweld" can be used in any flat or near-flat position.

Manual Lincolnweld *concentrates up to 600 amps on a 5/64" electrode. Welds 3 to 4 times faster. Welds are smooth and practically self cleaning.*

In the fabrication of these Gar Wood side frames, two men produce one pair of frames in only 8 hours. Each frame calls for 174 feet of welding. With hand welding 40 manhours were formerly required to do this work.

Duplicate benches are used for fabricating the right hand and left side frames. Two men working as a team set up, tack, and weld, using the "Manual Lincolnweld" for both "hidden-arc" and open arc welds.

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LATEST INDUSTRIAL LITERATURE

286 V-BELT DRIVES

Goodyear Tire & Rubber Co., Inc.—Booklet contains simplified reference tables so that the shop mechanic, farmer, or home hobbyist who wishes to design his own drive can use Goodyear belts and standard pulleys.

287 GAS-FIRED FUEL-OIL HEATER

Davis Engineering Corp.—Bulletin 60-L describes the Type GP Indirect Gas-Fired Fuel-Oil Heater, a combination steam-generator and vertically mounted steam oil-heater for use with No. 6 fuel oil systems. An automatically controlled gas flame generates low-pressure steam in the lower section. Steam passes in a closed circuit to the upper oil-heating section, and condensed steam returns by gravity to the lower section. Gas flame is not in contact with oil tubes. The heater provides quick starts for plants operating on weekend shutdowns, and enables use of No. 6 oil on processes where no steam boiler is available for oil preheating. It operates on any type of gas.

288 METAL BENDING

O'Neil-Irwin Mfg. Co.—The 32-page bending manual contains information on a wide variety of forming operations. The bending of tubing, angle, channel, and extrusions as well as solid materials is graphically illustrated. Detailed prints show the exact manner in which any rotary-type bending machine can be tooled for precision bending. The manual outlines the recommended steps in designing parts to be formed, choice of materials, and selection of bending equipment.

289 VISUAL TACHOMETER

Boulin Instrument Corp.—A 4-page, 2-color, illustrated bulletin summarizes specific uses and advantages of measuring rotary and vibratory speeds from a distance and without contact by means of visual hand tachometers. It cites numerous instances of use under widely different conditions in air conditioning, aircraft, automotive, chemical, oil, and textile industries.

290 DROP FORGINGS

Drop Forging Association—"Metal Quality—Hot Working Improves the Properties of Metal," a 64-page booklet recently revised and issued by the Technical Committee, Drop Forging Association, for design engineers, metallurgists, and production-management executives, explains how hot-working improves metal quality. The text describes forging-quality steel and details of the various methods of forging. Check lists of the advantages obtained by use of forgings, economic benefits, are included.

291 VIBRATION CONTROL

MB Mfg. Co., Inc.—Bulletin 1-VE describes and illustrates a complete line of vibration exciters and calibrators, vibration meters, and automatic cycling systems. Bulletin 124C describes a complete line of vibration pickups. Bulletin 410 describes a general line of equipment and isolators.

292 DUST-CONTROL EQUIPMENT

Dracco Corp.—A new 40-page bulletin No. 800 presents complete technical information on the extensive line of Dracco dust-control equipment. Multi-Bag Filters, Uni-Filters, Dustomatic Filters, "DH" Filters, and Whirl-Clones for the control or recovery of all kinds of industrial dust are featured. Also included are explanations of operational features, specifications in tabular form, and installation photographs.

293 ROLLER AND DETACHABLE CHAINS

Chain Belt Co.—Bulletin No. 52-2, distributed by the Baldwin-Duckworth Div., gives information on the Baldwin Assembly Riveted Roller Chain. List prices, strengths, dimensions, and weights of standard roller chains are included. Bulletin No. 53-10, distributed by Baldwin-Duckworth Div., covers "Tension Linkage" chains, described as chain applications in which linear movement of the chain is not continuous in direction; the chain may not be continuous.

294 TURBINE-TYPE AND CENTRIFUGAL PUMPS

Aurora Pump Co.—This 12-page condensed catalog has illustrated descriptions of turbine-type and centrifugal pumps in various combinations of capacities, heads, suctions, and designs, for all industrial purposes including water systems. Features, construction specifications, applications, and condensed selection information are given for each pump unit.

295 GAGES AND INDICATORS

Ernst Water Column & Gage Co.—Bulletin 11-1-52 has been released, covering some of Ernst specialties, such as bronze, iron, and stainless steel liquid-level gages; also trycocks, illuminators, and flow indicators.

296 ELECTRIC MOTORS

General Motors Corp., Delco Motors Div.—An 8-page bulletin illustrating Delco fractional horsepower motors, Delco single-phase general-purpose motors, Delco single-phase definite-purpose motors, Delco industrial motors, and Delco polyphase industrial motors. Featured is a cutaway showing exclusive Delco features.

297 MARKING TOOLS

M. E. Cunningham Co.—Bulletin J-547 describes the Cunningham line of "Safety" marking tools. It illustrates the standard line of marking devices and includes symbol charts and special codes.

298 DIAL SCALES

Fairbanks, Morse & Co.—Bulletin 8102 contains information on Fairbanks-Morse bench and portable dial scales. Clearance dimensions and capacities of the different models are included, with an explanation of the working mechanism of the scales. Accessory equipment is also listed.

299 DEWATERING ASH STORAGE BINS

United Conveyor Corp.—Bulletin illustrates special design for elevated ash storage bins which are required to receive a mixture of water and ash from a hydraulic conveying system and drain water from bin so that commercially dry ash can be loaded by gravity into railroad cars or trucks. Equipment is particularly suitable for the large boiler plants where there is no fill ground available that can be used as an ash fill.

300 ELECTRONIC AIR CLEANERS

Trion, Inc.—Catalog E-60 explains the electrostatic precipitation of dust, dirt, smoke, bacteria, and other contaminants, and the features of Trion electronic air cleaners. Capacities, dimensions, and weights of the different models available are listed, including specifications for packaged units. A 4-page folder on the Dill Dust-Spot Tester, manufactured to National Bureau of Standards design explains the instrument, which determines air filter efficiency, and gives its specifications.

301 WELDED STEEL TUBING

Bundy Tubing Co.—"Bundyweld Steel Tubing" has 12 pages of descriptive material covering physical properties, standard and special tubing sizes, recommended fabrication procedures, and applications where Bundyweld has been successfully used. Information is given on fabrication services provided by Bundy.

302 PUNCHES AND DIES

T. H. Lewthwaite Machine Co.—New, revised catalog sheets list the range of metal-working punches and dies carried in stock for immediate shipment. Styles to fit most makes of hand-, foot-, and power-operated punch presses are standard. Hand-operated punches, cutters, and benders are also illustrated and described.

303 MANOMETERS

Trimount Instrument Co.—Bulletin on Red Line manometers illustrates well-type manometers, absolute-pressure manometers, U-tube manometers, indicating flow meters, orifice flanges, and plates.

304 DUST COLLECTORS

Prat-Daniel Corp.—An 8-page catalog has been published illustrating and describing the company's Design 4P collectors. Contents include a discussion of the problems of fly-ash collection and the Design 4P tubular collector. Efficiency curves, arrangements, and standard dimensions are given, flue-gas density tables are included with a formula and nomograph for calculating the number of tubes required for any volume and resistance.

305 BRASS ALLOY

American Brass Co.—"Formbrite" is a fine-grain brass alloy described in Publication B-39, which gives some of its industrial applications and advantages. Advantages claimed for the metal are strength, hardness, springiness, and surface superior to ordinary drawing brasses.

YOUR

New Catalogs GUIDE

306 VENTILATING-HEATING UNITS

Trane Co.—"Unit Ventilators," Bulletin DS-340 shows the Trane Unit Ventilator system with wall-to-wall kinetic barrier action, as well as conventional Unit Ventilators. Construction, mechanical, and architectural specification are given. Also included are illustrations of cycles of operation, roughing-in dimensions, application suggestions, and both hot-water and steam capacities.

307 CONVEYORS

Fuller Co.—Bulletin G-1 describes four basic types of systems for conveying dry pulverized materials, such as cement, flour, or pulverized clay. Photographs and drawings of typical applications are included. Valves, aeration units, bin level-indicators, and other accessories and parts are shown.

308 ELECTRIC BRAKES AND CLUTCHES

Warner Electric Brake & Clutch Co.—Catalog No. 6069 contains information on complete line of electric brakes and clutches for industrial application, and contains description, torque values, and general data pertaining to all sizes. Complete capacity tables, dimensions, and specifications are included.

309 GAS-FIRED STEAM BOILERS

S. T. Johnson Co., Mears Kane Ofeldt, Inc., Div.—Bulletin 2J illustrates and describes the Kane gas-fired automatic steam boiler which is built to ASME specification in sizes from 1 to 30 hp for steam working pressure as high as 250 lb. Boilers are self-contained, automatic, require no attendant, and use minimum floor space.

310 ELECTRIC HOISTS

American Chain & Cable Co., Inc., Wright Hoist Div.—A 68-page Catalog E-53, lists the line of Wright Speedway Electric Hoists, in capacities up to 10 tons and lifts up to 152 ft. Complete clearance data and specifications are presented, including list prices. Ordering procedure is also given.

311 EFFECTS OF CHECK VALVES IN OVERCOMING WATER HAMMER

Williams Gauge Co.—The cause, effect, and control of water hammer in piping systems are considered in an 8-page bulletin. After describing water hammer in nontechnical terms, the brochure indicates its potential damage to piping, instruments, and other parts of water systems, and then considers methods of controlling it.

312 BOILER-WATER COLUMNS

Reliance Gauge Column Co.—New bulletin No. 516 describes boiler-water columns and gage equipment such as the original "alarm" water columns, remote reading water-level gage, liquid-level alarms, illumination equipment, gage valves, and gage cocks.

313 RESERVOIRS AND STANDPIPES

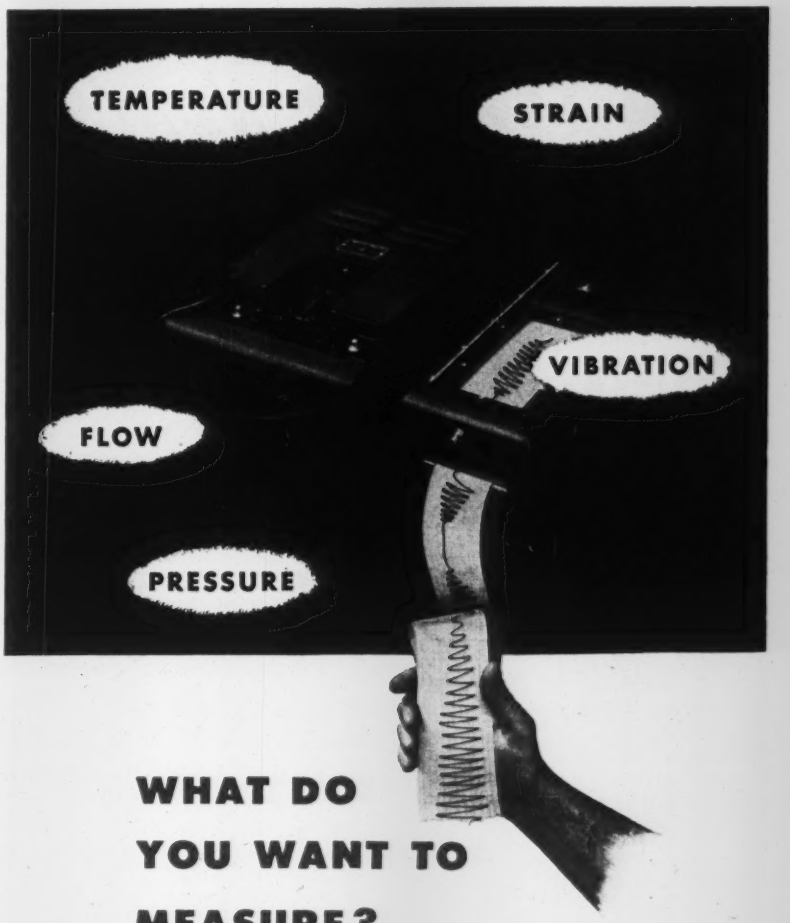
Chicago Bridge & Iron Co.—A 24-page booklet on "Horton Steel Reservoirs and Standpipes" contains illustrations of installations from 50,000-gal to 10,000,000-gal capacity with cone, umbrella, or ellipsoidal roofs and ornamental structures with special architectural features. Also included are table of standard capacities, information on foundations, the advantages of pickling and painting the plates used in building steel reservoirs and standpipes, and data on the use of suction tanks for fire protection.

314 SOLENOIDS

Cannon Electric Co.—Bulletin DCS4-1953 gives engineering and manufacturing data on a variety of direct-current solenoids with various mountings and end bell constructions for operating mechanisms such as landing gears, door locks, and switches. Graphs, schematic drawings and tables are included, as well as a looseleaf sheet of data on the hermetically sealed d-c solenoid, said to be the best combination for corrosion-resistance and wearing qualities.

315 SYNTHETIC RUBBER MOLDED PARTS

Allis Rubber Corp.—Catalog describes and illustrates the various kinds of rubber used in parts molding, as well as the processes involved in fabrication and the applications of the end product. Different parts are covered and a table of characteristics is provided comparing the various properties of five synthetic products with those of natural rubber.



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LATEST INDUSTRIAL LITERATURE

316 VALVES

R-S Products Corp.—Catalog No. 20, "Simplified Control and Shut-Off of Volume and Pressure," describes R-S valves in detail; types, prime movers, applications, and specifications are included. There are more than 150 illustrations.

317 HIGH-PRESSURE PUMPS

American-Marsh Pumps, Inc.—High-pressure triplex pumps, designed for applications including processing, compressing, and hydraulic-pressure testing, are described in a 6-page illustrated folder, Bulletin 295. They are available for 600 to 5,000 psi, in capacities from 1.1 to 16.5 gpm, in direct-drive and back-geared types.

318 HYDRAULIC TURBINES

James Leffel & Co.—Two new bulletins tell about recent Leffel hydraulic installations. Bulletin No. 1085 describes the Leffel installation at the Bureau of Reclamation's new Anderson Ranch Dam, with photos, statistics, etc. Bulletin No. 1086 contains information on a Leffel turbine used in the expansion of TVA's Wilbur Dam, with photos, field-test results, cross-section of installation, etc.

319 TEMPERATURE REGULATOR

Powers Regulator Co.—Bulletin No. 330 describes the operation and installation of the No. 11-MF self-operating (uses no electricity) temperature regulator for metal-finishing processes. The plastic used on the bulb and capillary is claimed to be tough, elastic, and extremely dense, and to have high electrical insulating properties. It is said to be satisfactory for all present-known applications in the metal-finishing industry. Various illustrations of typical installations are included as well as a table of valve capacities.

320 BELT CONVEYER IDLERS

Link-Belt Co.—More than 500 belt conveyer idlers in 34 types are pictured and described in 48-page Book No. 2416. All types of idlers for light-, medium-, and heavy-duty applications are featured—troughing, flat belt, belt training, rubber cushion, variable troughing, return—with information for proper selection and spacing, based on weight and lump size of material to be conveyed.

321 DIRECT-FIRED HEATERS

Arthur A. Olson & Co.—Catalog No. D52 contains information of gas, oil, coal, or dual gas-and-oil direct-fired automatic heaters, with capacities from 300,000 to 7,500,000 Btu per hr. Steps in the heater operation are explained with cutaway views, and data on the different models are given.

322 AIR PUMPS, SEPARATORS, CIRCULATORS

Kraissl Co.—A loose-leaf catalog gives data on the Kraissl line of equipment, indicating briefly the important features of each product. Recent loose-leaf additions to this catalog include the new Kraissl Class 23 Series Air Pumps which require no oil lubrication. Other data sheets describe the complete line of Kraissl Separators, including both strainers and filters, which have been listed as standard by the Board of Fire Underwriters for fuel oil service. The latest bulletin issued describes the new Kraissl Class 34 Series circulators.

323 DUST AND FUME COLLECTORS

Northern Blower Co.—Catalog 1002-6 describes exhaust fans for dust collecting and air handling and includes complete performance tables, test curves, etc. Plans and elevations of typical dust-collecting installations are shown. Separate additional bulletins contain descriptions, dimensions, capacities, etc. of Norblo bag type, hydraulic type, and centrifugal dust collectors.

324 SPREADER STOKER

Hoffman Combustion Engineering Co.—Catalogs 50 and 51 provide general information on spreader stokers as to available sizes, layout drawings, coal sizing data, branch offices, service facilities, etc.

325 CONTROL VALVES

C. B. Hunt & Son, Inc.—Bulletin No. 531 is a 12-page, illustrated compilation of information about Quick-As-Wink Control Valves, for engineers and purchasing agents. It covers the most widely used valves in the line including sliding-sleeve air valves, single-plunger valves, O and OE valves, and hydraulic valves.

326 TEMPERATURE CONTROL

Fenwal, Inc.—Catalog No. 400 gives information on the entire Fenwal temperature control and detection line except for new products manufactured within the past year. The catalog pictures the units in specific applications and gives performance specifications. Modifications and special features to the standard line are also discussed. Other products include Miniature Thermoswitch Controls, Midget Thermoswitch Controls, and Detect-A-Flo Control.

327 CUSTOM QUALITY METAL PRODUCTS

Falstrom Co.—Bulletin No. 142 gives three important steps in obtaining custom quality in metal assembly requirements. The booklet also describes metal fabricating, welding, and finishing facilities of the Falstrom Co., and illustrates various steel and aluminum cabinets, chassis, racks, cases, and subassemblies built up to $\frac{1}{4}$ in. thick plate to customer's specifications.

328 HUMIDITY CONTROL

Surface Combustion Corp., Kathabar Div.—A 4-page illustrated booklet describes the features of the Kathabar system of humidity control. Schematic diagrams explain the operation of the low-temperature coil system and wiring plans demonstrate various commercial applications of this equipment. The Kathabar System is said to be the first effective method of combining chemical dehumidification with mechanical refrigeration to obtain air of extremely low dew point, and at subzero temperatures.

329 TURBO PUMPS

J. S. Coffin Jr., Co.—A 4-page illustrated bulletin describes high-speed single-stage turbine-drive centrifugal pumps covering capacities to 800 gpm and discharge pressure up to 1500 psig. These units are one complete assembly with turbine and pump mounted on a common shaft with an integrally mounted hydraulic governing mechanism. They are designed for reliable, efficient service, in industrial, marine, and railroad installations.

330 INSULATING WOOL

Glass Fibers, Inc.—A 4-page illustrated booklet outlines the advantages of Microlite Insulating Wool, a low-density, resilient insulating material with high thermal efficiency and sound-absorption characteristics. Resistant to heat, fire, moisture, and corrosion; this glass fiber insulating wool is recommended where the greatest thermal and acoustical efficiency is desirable in the smallest space. Tables are included on thermal and acoustical performance.

331 TOOLS

Brown & Sharpe Mfg. Co.—Catalog No. 35 has 224 illustrated pages describing the complete line of Brown & Sharpe Small Tools. This line includes machinists' tools, electronic gaging equipment, Johansson gage blocks, cutters, hobs, arbors and adapters, screw machine tools, pumps, and miscellaneous items.

332 TEMPERATURE AND PRESSURE REGULATORS

Robertshaw Fulton Controls Co., Fulton Sylphon Div.—Well illustrated Catalog A describes the Fulton Sylphon line of regulators for temperature and pressure control. This catalog also gives technical information relating to relief valves, pump governors, safety and vacuum regulators. In all there are over 70 pages of illustrations, data, and drawings.

333 VALVES

Ohio Injector Co.—An easy-reference illustrated catalog gives engineering and manufacturing data on a line of bronze, iron, and cast and forged steel valves. Special tables and an index are included to facilitate selecting. The booklet also covers valve accessories and parts.

334 ELECTRONIC ANALOG COMPUTING DEVICES

George A. Philbrick Researches, Inc.—A revised general catalog covers the latest developments, new components, and prices of the complete GAP/R assemblage of electronic analog computing devices. This 8-page illustrated booklet includes much engineering data and general information on analog applications, and covers K-3 and K-4 series components. Material shows typical equations solved.

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

335 SPIRAL-WOUND GASKETS

United States Gasket Co.—Catalog No. AG-953 describes Ajax Spiral-Wound Gaskets for pipe flanges and for boiler manholes, handholes, and tube caps. It includes sizes for standard makes of boilers, waterwalls, heat exchangers, and allied power equipment, and for standard pipe flanges up to 24-in. diam, and is suitable for pressures to 1500 psi.

336 SLITTERS AND SLITTING LINES

Yoder Co.—A 74-page catalog presents basic information on design, selection, and operation of slitters and slitting lines; time studies and analysis of operating cycle; and coil handling and scrap-disposal methods. Specifications, capacity tables, and other data on Yoder standardized series of uncoilers, slitters, recoilers, coil cars, and scrap choppers are given.

337 HEAVY INDUSTRIAL EQUIPMENT

Newport News Shipbuilding & Dry Dock Co.—A 42-page, 2-color booklet illustrates the variety of heavy industrial equipment produced by the company, and the wide range of facilities used to produce them. This booklet should be of interest to concerns seeking appropriate facilities for the production of heavy industrial equipment.

338 MEASURING AND RECORDING INSTRUMENTS

Consolidated Engineering Corp.—New general catalog describes "Electromechanical" instrument systems for automatic measurement and recording of physical variables, such as pressure, vibration, acceleration, stress, strain, temperature, etc. Systems record up to 36 high-speed physical variables simultaneously. All instruments are described briefly and specific technical bulletins are listed on each.

339 VALVES

Wm. Powell Co.—New 589-page No. 11 General Catalog describes in detail the standard Powell bronze and iron valves, quick-opening valves, and all-iron valves.

340 BITUMASTIC PROTECTIVE COATINGS

Koppers Co., Inc.—Informative package of six bulletins covers (1) Bitumastic Hi Heat gray for high-temperature corrosion prevention; (2) Bitumastic Black Solution for general, low-cost maintenance; (3) Bitumastic Super-Service Black heavy-duty coating for more severe conditions; (4) Bitumastic No. 50, extra heavy-duty coating for extremely severe corrosive conditions; (5) Bitumastic No. 28, heavy-duty coating for atmospheric corrosion control; (6) Bitumastic Tank Solution, quick drying, useful for water tanks, etc.

341 BALANCING MACHINE

Taylor Dynamometer & Machine Co.—Bulletin No. 761 describes and illustrates manufacturing data and various applications of the Taylor Hi-Eff universal static balancing machine. Block diagrams feature the simplicity of operation and the advantages of this machine in reducing maintenance problems.

342 INDUSTRIAL PUMPS

Deming Co.—Ninety-six pages of illustrated information about numerous types of industrial pumps manufactured by the company are contained in Industrial Catalog I-52. The contents include sectional and exterior views of the various types of units, together with selection tables and other data of interest to pump users.

343 DRAWING PENCILS

A. W. Faber-Castell Pencil Co., Inc.—An illustrated booklet describes the advantages of Castell pencils and shows the relative shading of each of the 18 available grades. A chart shows the recommended first, second, and third requirements of different hardnesses of lead for different drawing and sketching activities in construction, industry, architecture, and surveying.

344 WELDED STEEL TUBING FABRICATING

Armco Steel Corp.—First edition of a 24-page booklet, "How to Fabricate Armco Welded Steel Tubing," gives general information on machines and accessories commercially available for tubing fabrication. It is useful to manufacturers who have never fabricated tubing, and also offers new cost-saving ideas to experienced tubing fabricators. Covers such subjects as cutting, deburring, bending, swaging, punching, drilling, joining, cleaning, and finishing.

345 SCREW CONVEYER

Link-Belt Co.—The 92-page Book No. 2289 contains detailed engineering data on screw conveyers and screw feeders, with selection tables and horsepower formulas, layouts and arrangements, dimensional data, and installation photographs. One table lists 250 materials and classifies them by size, flowability, abrasiveness, average weight, and other characteristics.

346 STEAM TRAP PROBLEMS

V. D. Anderson Co.—Bulletin No. 151 entitled "Solving Steam Trap Problems," contains 36 pages of illustrations, drawings, and charts, describing the importance of trap selection and showing application for various industries.

NEW CATALOGS GUIDE

. . . LATEST INDUSTRIAL LITERATURE

Beginning on page 43 the "New Catalogs Guide" offers readers of MECHANICAL ENGINEERING an opportunity to secure the latest industrial literature available. There are 429 items to make selections from. For convenience, an index can be found on pages 41 and 42. Select desired catalogs by number, fill in coupon on pages 42 and mail promptly. *Distribution by us to students is not included.* (*Must be mailed on or before date given on coupon.*)

INCREASE PRODUCTION . . . DECREASE COSTS WITH THESE LOW COST PRODUCTION TOOLS

Use CHROMALOX Electric Heaters to heat liquids, air and gases. Use them to heat platens, dies, molds and moving metal parts. Use them anywhere you want fast, economical and easy-to-control heat for production line processing. CHROMALOX Heaters are simple to install, efficient, come in types, sizes and ratings for working temperatures up to 1100° F. Most are available from stock.

FOR IDEAS ON HOW TO USE CHROMALOX HEATERS

WRITE FOR THIS HANDBOOK

EDWIN L. WIEGAND CO., Industrial Division
7646 THOMAS BLVD., PITTSBURGH 8, PA.
Send me the illustrated booklet "100 Ways To Apply Electric Heat" 19-31-A

Name_____
Company_____
Street_____
City_____ Zone____
State_____
I use heat for_____

CHROMALOX
THE BEST IN ELECTRIC HEAT

HOW
CHACE
THERMOSTATIC
BIMETAL
CONTROLS
THE
FLY-KING

FLY-KING, a constant, automatic instrument of destruction of flying insects, operates at a pre-determined temperature, protects 15,000 to 20,000 cu. ft. in safety and is guaranteed, because of a strip of Chace Thermostatic Bimetal which controls the unit.

In operation, the Fly-King is attached to a wall, up out of the way; its ceramic warming cup filled with a chemical supplied with the unit. A red pilot light indicates when the Fly-King is plugged in. It may be left connected permanently, the Chace Thermostatic Bimetal forever guarding its efficient and safe operation

Under the warming cup at the top of the unit is a clay heating brick (1) in which is mounted a strip of Chace Thermostatic Bimetal (2) and a contact spring (3). Each is fitted with an electrical contact point. An adjustment screw (4) controls the position of the spring. Current flows through the bimetal strip and spring when the contact points are closed, heating the element brick. As the temperature rises, the bimetal bends away from the spring. At 234 degrees F. the contacts separate and break the circuit. The bimetal then cools, the contacts close and the cycle is repeated to control accurately the evaporation of the chemical at its most effective rate.

So accurate is the control, that a quarter turn of the adjusting screw will change the maximum temperature limit 5 degrees.

This illustrates but one of the many applications of Chace Thermostatic Bimetal as the actuating element for temperature responsive devices. If your product responds to, indicates or controls temperature changes, actuate it with dependable Chace Thermostatic Bimetal. Write today for our 32-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

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347 DOUBLE-SEATED DIAPHRAGM CONTROL VALVES

Leslie Co.—Leslie Double-Seated Diaphragm Control Valves are described in 12-page Bulletin 5305. Engineering data on double-seated valves from 1½ in. to 10 in. Sizing and selection are aided with complete CV tables, capacity tables, material designations, and pressure-temperature limits.

348 RUBBERIZED ABRASIVES

Cratex Mfg. Co.—Catalog No. 53 presents the adaptability, versatility, and application of Cratex Rubberized Abrasives, together with specifications and prices. The catalog contains a treatise on rubberized abrasives on burring, smoothing, and polishing operations and their use in industrial establishments. Cratex Rubberized Abrasives are manufactured in wheels, points, blocks, sticks, and cones for machine or manual application, in four standard "grit-types" ranging from relatively coarse to extremely fine textures.

349 BOILERS AND STOKERS

James Leffel & Co.—A 28-page Bulletin No. 236, describes 6-hp and 250-hp (these are normal and conservative ratings and are subject to considerable overload capacities) Leffel Scotch-type boilers and underfeed stokers. Photos and cutaway drawings show design and application details. Test results, case studies, and specification data are included. The Leffel automatic underfed stoker is also suitable for other makes of Scotch-type boilers.

350 STEEL PLATE SHAPES

By-Products Steel Co.—"Steel Plate Shapes" is a 2-color bulletin describing how machinery builders can save by having their components formed for them from steel plate. Actual illustrations of examples of shapes that have been flame-cut, sheared, pressed (both small and light, large, and heavy) blanked, bent, or welded, are shown.

351 HYDRAULIC VANE PUMP

Denison Engineering Co.—Bulletin P-5 fully describes new Pump/Motor, which is usable as either pump or motor without alterations of any kind. Designed for use up to 2000 psi, the Pump/Motor is completely radially balanced. Interchangeable cam rings offer eleven different pumping capacities from 2.7 to 70 gpm, plus motor torque ratings from 13 to 257 in.-lb per 100 psi.

352 PRESSURE SWITCHES AND VALVES

Barksdale Valves.—Catalog 3G gives information on "Shear-Seal" Valves, manual and solenoid operated, pressures 250, 1500, 3000, and 6000 psi (manual valves only); shut-off and selector flow patterns. Crescent solenoid-operated, pilot-controlled air valves to 150 psi, diaphragm, bourdon tube, and piston pressure switches for operation on vacuum or pressures to 12,000 psi are included.

353 ADHESIVE, COATING, AND SEALERS

Minnesota Mining & Mfg. Co., Adhesives and Coatings Div.—A 2-color, 8-page bulletin gives data to facilitate selection of industrial adhesives, coating, and sealers. Photographs supplement tabular material and illustrates examples of fastening plywood to metal, cork to metal, vinyl to wood, glass fiber to metal, paper to metal, and rubber to metal. The tables have column headings covering the uses of each type; method of application; color; base; solvent; viscosity; per cent solids by weight; and net weight in pounds per gallon.

354 EXPANSION-JOINT DESIGN GUIDE

Flexonics Corp.—A 24-page Flexon Expansion Joint Design Guide, Catalog 135, covers engineering application and selection data necessary to the proper solution of pipeline expansion problems. Features of the Flexon Design Guide include a discussion of the various types of expansion joints on the market, the many types of Flexon Expansion Joints available, and types of pipeline motion solved by expansion joints; also expansion joint design considerations, installation instructions, and selection data. The center spread of the catalog is devoted to a schematic piping layout illustrating various expansion joint applications and principles.

355 VIBRATION FATIGUE TEST MACHINE

All American Tool & Mfg. Co.—Brochure describes their model 100 HL-A machine, featuring work table with tapped holes in symmetric pattern, mounted on four linkage arms, and equipped with ground steel pins and Super Oilite bushings. Unit subjects parts up to 100 lb to vibration fatigue test.

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

356 FILTER

Andale Co.—Bulletin 81353 gives instruction for installation, operation, and maintenance of the Andale Type 109 Filter or Grease Extractor for working pressures up to 125 psig. It has a cast iron body, is bronze mounted, and has OS&Y disk type valves. The linen terry wrap, supplied as part of cartridge, is removable and cleanable. The unit is for use on pipes 2 to 10 in. Parts list is included.

357 WELDING

American Welding & Mfg. Co.—Bulletin CA-50 discusses fabrication by controlled technique flash-butt welding. Illustrated are a variety of welded rings and bands and weldments. The bulletin discusses research engineering, fabrication technique, scientific inspection, and precision machining with many successful welding problems.

358 HYDRAULIC FLUID

E. F. Houghton & Co.—Folder describes a nonflammable hydraulic fluid which claims maximum fire resistance with top hydraulic efficiency. It is said to satisfy the need for a safe, non-toxic, noncorrosive liquid that can be used in hydraulic equipment operated near open flames or adjacent to extreme heat conditions. This fluid, known as Houghto-Safe, has been under plant test for over two years and is rated as an "acceptable" hydraulic fluid from the fire hazard standpoint by the Factory Mutual Engineering Division.

359 COMBINATION OIL-GAS BURNERS

Anthony Co.—New Data Sheet BG-H describes in detail the Anthony Nebulyte Combination Oil-Gas Burner, and includes a capacity table, selection chart graph, dimension drawings and typical layouts of burners and accessories. Also available are new Data Sheets BA and BD covering low- and high-range industrial oil burners and Bulletin 501 on the Anthony Proportioning Burner.

360 VALVES AND FILTERS

Automatic Switch Co.—Asco Solenoid Valves are described in Catalog No. 24, which includes a valve-selection chart of recommended valves for classes of fluids, flow charts, and general information and terms for the valve user. Safety shut-off and manual reset valves, packless and packed valves, three-way valves, pilot-controlled valves, four-way valves, and strainers and filters are covered. Special Bulletin 8336, "Solenoid Pilot-Controlled Valve," Bulletin 8035, "Pressure-Operated Manual-Reset Valve," and a Valve-Delivery Schedule for orders, all printed separately, are available.

361 RIGHT-ANGLE GEAR SPEED REDUCER

D. O. James Gear Mfg. Co.—Catalog 42-B gives over 84 illustrated pages of data on Right-Angle Gear Speed Reducers using parallel and vertical drives with ratios from 1:1 to 1100:1 and rating form 0.14 hp to 350 hp. Specifications and recommended practice for selection are included.

362 REVERSING VALVE STEAM ENGINES

Soule Steam Feed Works—"Steam Feed" booklet contains full description of twin-cylinder steam engine rated 16 hp with 100 lb steam at 300 rpm. Speed and direction of operation obtained by one throttle valve. Originally sawmill carriage feed engine, it is suitable for any use requiring these characteristics. Many are in use operated by air.

363 FORGING AND CASTING PRODUCTS

Allegheny Ludlum Steel Corp.—Booklet covers the products of the Forging and Casting Division. This booklet gives information on air and oil hardening cast to shape tool steel; also composite die sections and a wide range of tool and stainless steel forgings.

364 PLANT LAYOUT SYSTEM

Peerless Photo Products, Inc.—An illustrated bulletin tells how conventional plant layout procedures which entailed high cost and many man-hours of drafting are now replaced with a low-cost plant layout system involving the use of photocopy. Countless prints of the master layout are said to be possible on a Peerless "Magic Hand" vacuum-bed printer without damage to the original or loss of sharp reproduction. A complete file of successive plant layout prints is always on hand, with minimum cost and labor.

365 ELECTRONIC EQUIPMENT

Hewlett-Packard Co.—Catalog describes the line of -hp- electronic test equipment. It supplies photographs, description, specifications, and application data for oscillators, vacuum-tube voltmeters, signal generators, distortion-measuring equipment, frequency-measuring equipment, coaxial test equipment, waveguide test equipment, power supplies, amplifiers, and pulse generators. A brief outline of the equipment is given on the front cover and fly-page, and the catalog is indexed both as to subject matter and model number on the rear pages.

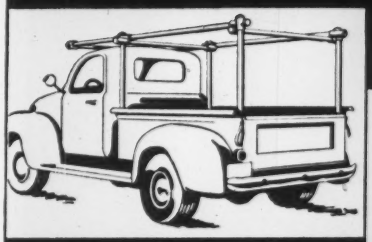
366 PLUG NUTS

Lamson & Sessions Co.—A leaflet lists the advantages of Lamson plug nuts over other types and explains briefly how plug nuts work, with illustrations.

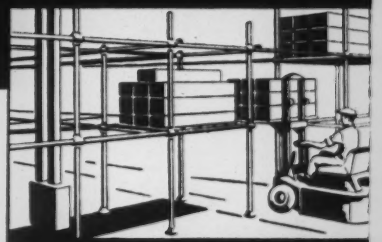
367 BEARING BRONZE

Bearium Metals Corp.—Three-color, 6-page folder describes the frictional properties available in Bearium Metal and illustrates typical bar stock sizes and individual castings. Photomicrographs

Structural Uses for
ALCOA ALUMINUM PIPE

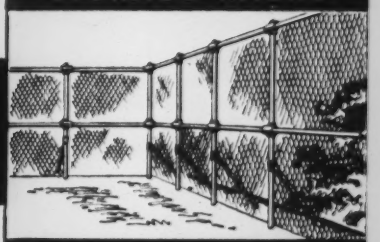


TRUCK RACKS



STORAGE RACKS

Quickly, easily assembled with Nu-Rail Slip-On Fittings of Alcoa Aluminum. Other types of fittings also available.*



FENCE FRAMES

*Manufactured by Hollaender Manufacturing Company 3841 Spring Grove Avenue, Cincinnati 23, Ohio

Advantages of Alcoa Aluminum Pipe:

1. **LOW MAINTENANCE COST**—Withstands most contaminated atmospheres without paint.
2. **GOOD APPEARANCE**—Bright, clean-looking.
3. **STRONG**—Has excellent mechanical properties.
4. **LIGHT**—Weighs 1/3 as much as steel, size for size.

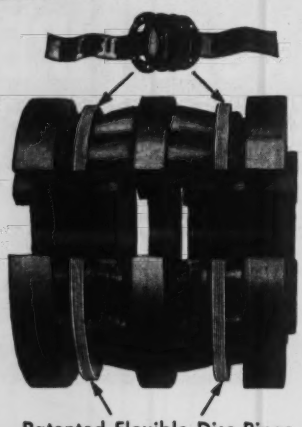
With all these advantages, first cost is moderate. Schedule 10 costs little if any more per foot than Schedule 40 steel.

Most ALCOA distributors and jobbers stock Schedule 10 and 40 pipe and fittings in standard sizes. ALCOA can supply other sizes to your specifications. Consult your local ALCOA sales office or write: ALUMINUM COMPANY OF AMERICA 903-L Alcoa Building Pittsburgh 19, Pa.

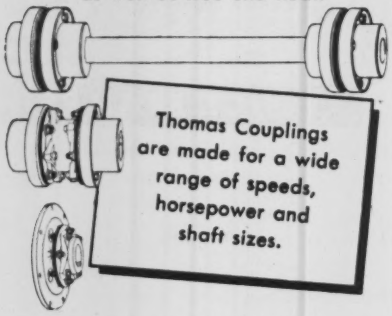
Alcoa Aluminum

Specify **THOMAS** ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs

DISTINCTIVE ADVANTAGES	
FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.



Thomas Couplings are made for a wide range of speeds, horsepower and shaft sizes.

THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT

NO MAINTENANCE PROBLEMS

ALL PARTS ARE SOLIDLY BOLTED TOGETHER

Write for our new Engineering Catalog No. 51

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

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LATEST INDUSTRIAL LITERATURE

show structure and lead distribution achieved in production of this metal, accounting for its advantages for bearings, bushings, thrust washers, and other requirements involving rubbing friction.

368 AUTOMATIC BAGGING AND PROPORTIONING SCALES

Richardson Scale Co.—Bulletin No. 0450 describes complete line of automatic bagging scales, packers, proportioning scales, process control panels, remote weight-setting equipment, continuous weighers, compounding bins, and list of over 200 materials handled.

369 CONDENSER CIRCULATORS

C. H. Wheeler Mfg Co., Economy Pumps, Inc., Div.—Catalog G-1050 describes double suction pumps to 54 in.; axial and mixed flow to 150,000 gpm. Designs are available for all conditions, cast or fabricated, with special materials for sea water. "Pull-out" type is also available.

370 PROGRESSING-CAVITY PUMP

Robbins & Myers, Inc., Pump Div.—Bulletin 30-C describes the Moyno Progressing-Cavity Pump. A helical rotor turning within a double-helical stator provides a gentle, positive displacement that will not break up semi-solids or aerate liquids. The pump is self-priming and will not vapor-lock or cavitate. No valves or pistons are used.

371 BRONZE BEARINGS

Chrysler Corp., Amplex Div.—Bulletin S-53 describes and illustrates 700 Oilite Bronze Bearings an Oilite Cores, Bars, and Plates stocked "for immediate delivery" by Oilite dealers and depots throughout United States and Canada. In addition to manufacturing and technical data, the catalog gives instructions for machining Oilite bronze, finishing the bore, handling of bearings, and other tabular processing information.

372 THERMAL LIQUID HEATERS

International Boiler Works Co.—Catalog describes International-LaMont Thermal Liquid Heaters designed for continuous operation at temperatures to 750 F, and constructed on the exclusive LaMont principle of forced re-circulation for high-temperature heat transfer. Units are packaged with oil or gas burners, forced-re-circulation pump, induced-draft fan, and all controls. The heaters are built in standard sizes from 250,000 to 2,000,000 Btu hr, and are also available in larger capacities (Type LFS) to 10,000,000 Btu per hr.

373 INDUSTRIAL X-RAY UNIT

General Electric Co., X-Ray Dept.—A 4-page bulletin describes the features, specifications and basic designs of the GE Resotron 250. This is a 250,000-v industrial x-ray unit, which is portable and lightweight.

374 COMPRESSION PIPE COUPLINGS

Morris Coupling & Clamp Co.—Illustrated pamphlet gives specifications, prices and economy features of the Morris Economy compression pipe couplings, for original equipment manufacture applications. These couplings join pipe without threading to form a positive seal in less than one minute. They are available in sizes $\frac{1}{2}$ to 4 in.

375 WELDING

Lincoln Electric Co.—"Elements of Weldesign" is a series of pamphlets issued periodically to design engineers, production men, and management executives. Current series outlines fundamentals of how to design with steel, how to reduce costs, and steel design fundamentals with special charts and checking information.

376 DUAL DRIVE ADAPTER

F. W. Stewart Corp.—Bulletin describes "Circle Ess" Dual Drive Adapter for use in conjunction with flexible shaft drives where more than one unit is to be driven from the same power source; to provide two ratios from the same source or to facilitate attaching flexible shaft drives where limitations in space prevent direct connection without bending the shaft to the point of possible damage. Furnished with standard $\frac{5}{8}$ in. × 18 threaded connections with 0.104-in. internal square drives and in ratios of 1 to 1, 15 to 1, 16 to 1, and 17 to 1 for either left or right rotation.

377 SELF-CLEANING STRAINERS

Leslie Co.—Twelve-page Bulletin 5308 on Leslie Y-type self-cleaning strainers shows selection of protective strainers. Liquid and steam pressure-drop tables, complete dimensions data, and variety of screen materials are included.

378 BLOWERS

Hartzell Propeller Fan Co.—Catalog B-10 covers Hartzell belt- and direct-drive utility blowers, with ratings and principal dimensions for the various wheel diameters. Performance data for utility blowers (National Association of Fan Manufacturers Arrangement 3) and belt-drive utility blowers are included.

379 ELECTRONIC FLOW METER AND TRANSMITTERS

Hays Corp.—A 4-page illustrated pamphlet describes the features and component of three mercury-less, bellow-type transmitters. It also covers an electronic flow meter which indicates, records, and/or provides continuous integration of air, steam, gas, or liquid flow. Other products are also described.

380 STEAM TRAPS

Strong, Carlisle & Hammond Co.—Strong Steam Specialties Catalog 68 ME illustrates and describes Strong Steam Traps, inverted-bucket, open-float, and thermostatic type, line strainers, pressure-regulating valves, pressure-reducing valves, separators, and steel "Evrtyte" valves. Engineering Sections provide helpful suggestions, cut-away drawings, charts, dimension tables, and pertinent engineering data to simplify ordering and specifying.

381 CELLULAR RUBBER

Sponge Rubber Products Co.—Properties of and test data on cellular rubber are described in a 20-page explanation of grades, compression, influence of heat and aging, flexing, tensile and elongation, insulation value, special purpose stocks and specifications for open-cell and soft and hard closed-cell rubber.

382 ELECTRIC MOTORS

Reuland Electric Co.—A 6-page folder describes and illustrates the features of Reuland polyphase or single-phase electric motors. Standard motors, slip-ring motors, Motoreducer speed reducers, Fluid-Shaft motors, and "Utility" grinders are covered.

383 LUBRICATING SYSTEM

Trabon Engineering Corp.—Bulletin No. E463 describes operating principles and engineering data on type M and MX oil and grease systems for all types of machinery. Fully hydraulic positive-piston-type valves measure lubricant in volumes from 0.010 to 0.15 cu in., use no springs or ball check valves.

384 FORCE-MEASURING DEVICE

Hagan Corp.—The Hagan "ThrusTorq," air-operated force-measuring device, is pictured and described in Bulletin No. 9345. The ThrusTorq is employed in engine-testing laboratories, engine and aircraft factories, automotive and petroleum industry laboratories and plants, and in chemical and other plants for continuous and intermittent weighing applications.

385 BOILER CONTROL

Continental Foundry & Machine Co., Copes-Vulcan Div.—The Bulletin No. 1007 introduces Copes-Vulcan Boiler Control with instrumentation by Taylor. A new approach to the subject is described, complete with typical schematic views including a modern graphic panel in full color.

386 SOLVENT-RESISTANT RUBBER

B. F. Goodrich Co., B. F. Goodrich Chemical Co. Div.—"Everywhere in Industry It's Hycar American Rubber" describes the properties and advantages of "Hycar" oil- and solvent-resistant synthetic rubber. A chart of the different types of this rubber gives their special properties and suggested uses. Vinyl and phenolic resin blends are included.

387 HEAT-TRANSFER EQUIPMENT

Griscom-Russell Co.—A pictorial bulletin illustrates and concisely describes many types of heaters, coolers, condensers, and exchangers for various industries.

YOUR *New Catalogs* GUIDE

388 SOUND-MEASUREMENT INSTRUMENTS

General Radio Co.—A 12-page bulletin describes in detail instruments for the measurements and analysis of sound and vibration. Complete specifications are given for each instrument together with illustrative examples of applications.

389 TECHNICAL BOOKS

The American Society of Mechanical Engineers—1954 Catalog of ASME Publications is a 20-page descriptive price list of current books, standards codes, research reports, and periodicals published by the Society.

390 V-BELT DRIVES

Allis-Chalmers Mfg. Co.—Bulletin 20B6051N carries the procedure for figuring "Texrope" V-belt drives by means of tables, together with examples of how to use the engineering information given. The bulletin also describes "Texrope" belts, sheaves, and speed changers.

391 FLOW SIGNAL TRANSMITTER

Hagan Corp.—The Hagan flow signal transmitter is described in a new bulletin, No. 2551. This pneumatically operated pressure-differential measuring unit transmits proportional signals to remote recording or indicating instruments, or to automatic control elements. The signals may be linear with flow or linear with pressure differential. Diagrams in the bulletin illustrate seven suggested uses of the transmitter in measurement of flow, liquid fuel, liquid level, and absolute pressure. Flow applications include measurement of steam output from a boiler, superheater or evaporator; of feedwater flow to a boiler; of liquid flow through pump units; and of gas, vapor, or liquid flow in process systems.

392 VALVES

Homestead Valve Mfg. Co.—Reference Book 39-3 offers complete information on Lever Seald Valves made of brass, semisteel, cast steel, and other metals for specific service conditions. Specifications for these valves, which feature "stickproof" operation, are given in charts, with photos and line drawings illustrating each type valve. Also included in this 16-page catalog are on-the-job photos of Lever Seald Valves, illustrating their many uses.

393 PIPE AND TUBES

National Tube Co., Tubing Specialties Div.—Bulletin 26 presents technical data on 25 alloy steels suitable for high-pressure high-temperature service. Includes many tubular products manufactured in accordance with ASME Boiler Code specifications. Relative cost figures aid in selecting best alloy for special service.

394 GAGES

Rochester Mfg. Co., Inc.—An 8-page catalog of Rochester pressure gages, temperature gages, liquid level gages, and ammeters and pressure and temperature switches illustrates and gives dimensions of each model, with other specifications. Available connections and recommended uses are given, with ordering instructions.

395 VENTILATION FILTERS

Dollinger Corp.—Model WKE Dry Panel Filters for ventilators and air conditioners are described in Bulletin 600, 8 pages. The Model WKE is available in several sizes, and a table gives capacities and other specifications for each size. Curves showing performance characteristics are given. Information for selection and installation is included.

396 PNEUMATIC INDUSTRIAL CYLINDERS

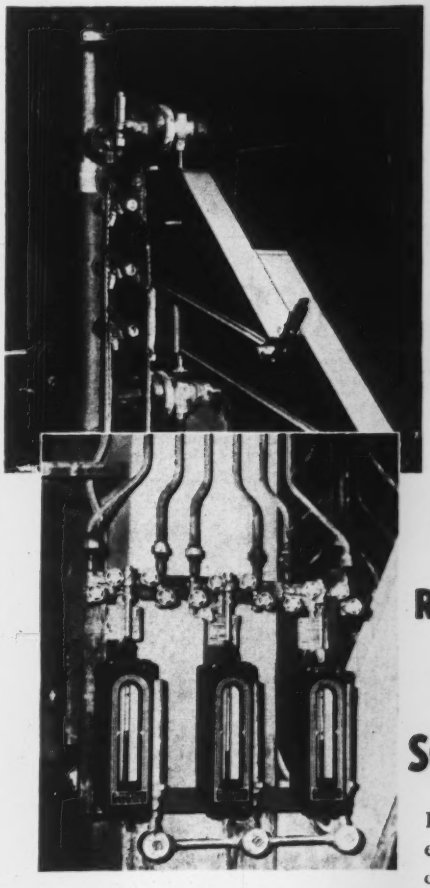
Westinghouse Air Brake Co.—A new streamlined class of pneumatic industrial cylinders—both with noncushioned and cushioned adjustable stroke—are described in Leaflet No. 9458-I. Solid barrel construction with rotating heads provides compactness and ease of installation. They are available in diameters from 1½ in. up with stroke and mounting to suit any requirement.

397 STEAM-GENERATING EQUIPMENT

Kewanee-Ross Corp.—The 32-page Kewanee General Catalog 80 gives full description and complete data on entire line of boilers, boiler-burner units, and other equipment for heating, power, or process steam. It includes diagrams of small residential types up to large industrial sizes of 304 hp, for steam or water, high or low pressure, mechanically fired.

IT TAKES *Double Supervision*

to assure full safety from water level failure



Reliance Safety Team warns operators by SOUND and by SIGHT

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BOILER SAFETY DEVICES

YOUR

New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

398 ELECTRIC MOTORS

Jack & Heintz—Folder describes custom-built electric motors for variety of uses. Motors can be specially engineered for applications requiring odd voltage or frequency, polyphase, direct current, quick reversing, special mounting, special shaft specifications, and custom painting.

399 WATER PROBLEMS

Hall Laboratories, Inc.—Industrial water problems of all kinds—procurement, treatment, usage, and disposal—and the facilities and services offered in coping with them are described and charted in a new booklet.

400 INDIRECT FIRED HEATER

Brown Fintube Co.—Fired indirect heater for heating air, special atmospheres, corrosive and non-corrosive gases, thermal chemicals and circulating oils, asphalts, and other services requiring temperatures up to 1500 F. The 2-in. to 8-in. finned combustion tube is of carbon-steel stainless-steel, inconel, or monel construction, and gas or oil fired. It delivers up to 1,000,000 Btu per hr input to the material. Bulletin No. 522 gives full information, including operating details of 12 typical installations.

401 SHADED POLE MOTORS

Fasco Industries, Inc.—Catalog describes full line of shaded pole motors of the 2, 4, and 6 pole types, ranging from 1/500 to 1/4 hp. Dimensions, electrical characteristics, and curves are included. All motors manufactured are suited for use on either 110 or 220-v 50 or 60 cycle, current.

402 SOOT BLOWERS

Diamond Power Specialty Co.—Catalog No. 1014 describes the complete line of Diamond soot blowers for both air and steam cleaning and having manual, air or electric operation. Completely automatic sequential systems are described and their advantages discussed. This catalog also contains some interesting background material indicating that soot is a better insulator than asbestos.

403 LIQUID METERS

Buffalo Meter Co.—Catalog of Niagara Industrial Meters, Bulletin No. 31, describes the company's line of volumetric meters for industrial liquids including chemicals, oils, solvents, hot water, cold water, syrups, acids, and alkalies. Automatic batch-measuring equipment is described.

404 OPTICAL-GAGING SHAFT INSPECTION

Optical Gaging Products, Inc.—"Shaft Inspection by Optical Gaging" describes the optical gaging method of checking location of shoulders and grooves on a number of shafts of similar types, ranging in lengths from 2 1/2 in. to 7 in. and diameters from 1/4 in. to 1 in., with differing shoulder and groove location. Advantages claimed are speed, precision, economy, minimum operator training, and minimum operator fatigue.

405 BEVEL GEARS

Gleason Works—"Bevel Gear Manufacture...the Gleason System," by George Hessler, 16 pages, is offered as an explanation of the tools, and techniques used by Gleason for the production of bevel gears, including straight, zerol, spiral, and hypoid types. Diagrams and photographs, as well as extensive text, show these types of bevel gears and their manufacture.

406 METAL TURNINGS CRUSHERS

American Pulverizer Co.—Bulletin describes the American Rolling-Ring metal turnings crushers, for the reduction of machine turnings to shovelling chips. For plant production of 10 tons or more metal turnings scrap per month, this bulletin shows how to realize savings in oil, man-hours, factory space, and tool maintenance. Models, described with capacities from 2 1/2 tons per hr to 10 tons per hr.

407 PHOTOELECTRIC COUNTER

Photoswitch, Inc.—Bulletin PA506 describes a completely packaged general-purpose photoelectric counter, Photoelectric Counter Set PTC. The set consists of a photoelectric control, light source, and electric counter; remote counting is possible with the device, standard 115-v a-c power is utilized, and counting speed of up to 600 counts per min is claimed.

408 METAL CHIP CONVEYERS

National Conveyers Co., Inc.—New bulletin containing illustrations, drawings, and descriptive data of National ChipVeyor systems tells how metal turnings are crushed, conveyed, and stored and how valuable cutting oil is reclaimed for reuse.

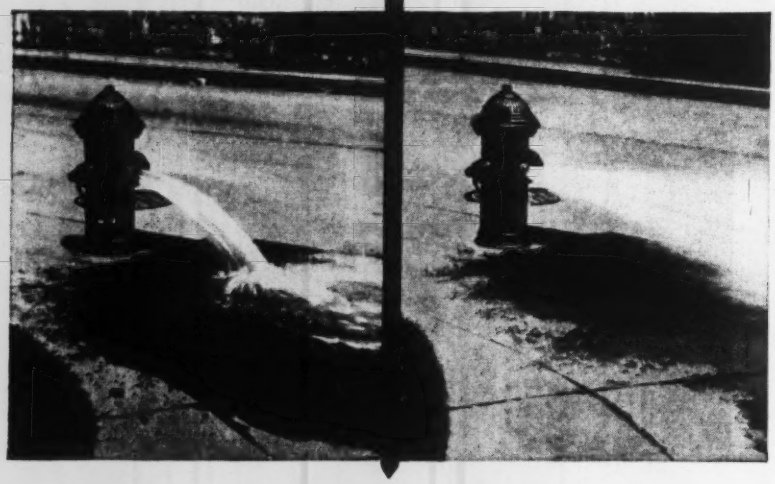
409 TEMPERATURE AND PRESSURE INSTRUMENTS

American Machine & Metals, Inc., Gotham Instruments Div.—Catalogs No. 100 ("Industrial Thermometers"), 200 ("Dial-Type Thermometers"), 400 ("Recorders"), and 500 ("Controllers") describe industrial and dial thermometers, and temperature and pressure recorders and controllers of both pneumatic and electric types. Specifications for all instruments are given.

410 RETAINING RINGS

Waldes Kohinoor, Inc.—Their 52-page catalog covers Waldes Truarc retaining rings, including 28 pages of engineering and specification charts, 6 pages of field applications and case histories, 18 pages devoted to Truarc pliers, assembly, and accessory tools, and other relevant information pertaining to the most advantageous use and selection of Truarc retaining rings.

from this... to this...



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YOUR *New Catalogs* GUIDE

411 PILLOW BLOCKS

Fafnir Bearing Co.—The 4-page illustrated folder describes a new low-cost, light-duty ball-bearing pillow block with separable two-piece pressed steel housing. Exploded views, suggested applications, available sizes, dimensions, and load ratings are shown.

412 TUBE CLEANERS, EXPANDERS, AND INSERTS

Thomas C. Wilson, Inc.—A comprehensive Catalog 76–A, of 48-pages, shows a full line of mechanical tube-cleaners for the cleaning of fouled boiler, evaporator, and condenser tubes. Bulletin 380-A is also available depicting a line of Wilson tube-expanders for all tubular assembly purposes. For the salvage of eroded or corroded heat exchanger or condenser tube ends, Wilson condenser tube inserts have just been marketed. Bulletin 500 describes this new item.

413 CLUTCHES

Borg-Warner Corp., Rockford Clutch Div.—Bulletin 4A/13 is a catalog condensation of a wide variety of types and sizes of clutches, both automotive and industrial, which also describes power take-off and gear reduction units. Illustrations are included, with description and specifications.

414 COMBUSTION EQUIPMENT

Hauck Mfg. Co.—The Catalog 52 gives a condensed and pictorial review of oil and gas combustion equipment for production, construction, and maintenance applications in industry. The catalog has 12 pages and 80 illustrations, arranged for readers' convenience.

415 SOOT BLOWERS

Hahn-Pitz Corp.—New Bulletin No. 71 describes mechanical soot-blowers for fire-tube boilers. Adaptable to H.R.T., Scotch marine and fire-box types, these blowers have no moving parts within the boiler, with no scoring of the tube sheet. For existing boilers or new installations.

416 DRAFTING-MACHINE SCALES

Universal Drafting Machine Corp.—Bulletin gives complete information on the advantages of this extremely accurate, ground from the solid, aluminum scale and in addition provides a valuable chart of 3/4 size actual scale photographs showing all the standard Duraline Scale graduations commonly used by engineers, draftsmen, architects, and designers. It also provides an explanation of scale terminology in general use—to aid buyers when writing for information on specially graduated scales for special uses.

417 FIBERGLAS STRUCTURAL PANELS

Resolite Corp.—A new 12-page catalog describes Resolite translucent structural panels of Fiberglas-reinforced plastic, manufactured in 8 standard colors and tints. In addition to specifications, loading, and light-transmission values, and other physical characteristics of this building material, the catalog pictures suggested structural applications with detailed drawings for home or office partitions, patio covering, building facing, industrial skylighting, toilet and shower stalls, and other practical uses.

418 BOILERS

Farrar & Trefts, Inc.—Catalog describes heating and power boilers of welded construction with a range in capacities from 10 hp to 350 hp, and in working pressures from 15 lb to 500 lb; heating boilers for low-pressure, steam and hot-water service; and, power boilers built to meet all code requirements and carrying S.B.I. label.

419 CENTRALIZED LUBRICATION SYSTEMS

Farval Corp.—New Bulletin No. 26 provides a complete explanation of the Farval Dualine System of Centralized Lubrication and its advantages as a means of saving oiling labor, lubricant, bearing, expense, and production time for various types of heavy industrial equipment. Its 20 pages are illustrated with photographs, drawings, and diagrams.

420 DUST FILTERS

W. W. Sly Mfg. Co.—Catalog describes dust filter equipment of the cloth-bag type for efficient collection of fine dusts from industrial operations. One type of filter has a motor-driven shaker for removal of collected dust; another filter, the Sly Dynaclone, employs the "reverse air" principle for dust removal.

ADVANCE PERSONAL EDITION KEWANEE GENERAL CATALOG 80

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Here is the latest most authentic and complete data and dimensions on the entire Kewanee line.

You most likely need the material in this 32-page fully illustrated technical catalog now so there will be no delay in detailing new building and remodeling work you have in the planning stage.

The catalog is written especially for you and can be used as an authentic technical reference source. It is your own personal edition available in advance of Sweets and Domestic Engineering catalogs for 1954.

The catalog will contain full description of such products as . . .

1. *High and low pressure commercial and industrial boilers.*
2. *Residential Boilers*
3. *Water Heating Equipment*
   (a) *Direct fired types*
   (b) *Storage types*
   (c) *Indirect water heating coils for Kewanee Boilers*
4. *Boiler support brackets and structural steel suspension for Kewanee Boilers.*
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New Catalogs GUIDE

LATEST INDUSTRIAL LITERATURE

421 DIRECT-FIRED HEATERS

National Heater Co.—Bulletin 620, 4 pages, describes National Champion direct-fired heaters, with photographs. A table of capacities for the different sizes and models is included, with dimensions of units. Accessory equipment is shown.

422 MARKING MACHINE

Jas. H. Matthews & Co.—The Matthews No. 204 general-purpose marking machine is described in a 4-page leaflet. Round, flat, or contoured parts can be marked using the "rolling" principle of the machine, the advantages of which are explained and illustrated.

423 STEAM GENERATORS

Preferred Utilities Mfg. Corp.—Bulletin 2000 contains a description of the principal design features of the four-pass Preferred Unit Steam Generator. A complete list of standard and accessory equipment plus a table of dimensions is also included.

424 ELECTRIC MOTORS AND GENERATORS

Star-Kimble Electric Co.—Bulletins B201, B202, B301, B302, B501A, B1001 and B1301 cover polyphase squirrel-cage motors, squirrel-cage induction motors, wound-rotor induction motors, single-phase repulsion motors, a-c and d-c brake motors, d-c motors and generators, and motor-generator sets, respectively. Brief descriptions and specifications are included for each.

425 BORE INSPECTION

American Cystoscope Makers, Inc.—"Precision Instruments for the Exacting Inspection of Internal Surfaces" is the title and a good summary of the contents of a 12-page booklet on industrial telescopes for the inspection of small bores. Hole diameters through which the instruments can be passed range from 0.120 in. to 0.253 in. Supplements cover new models and specification data.

426 DESIGN AND FABRICATION

L. O. Koven & Brother, Inc.—"Koven Men, Facilities, 'Know-How'" describes the advantages offered by Koven in the design and fabrication of standard and special metal equipment. The facilities and capacities of each item of Koven-owned fabricating equipment are given.

427 BOILER FURNACE REFRACTORIES

Carborundum Co., Refractories Div.—Form No. 5117 covers Carborundum's line of super refractories for boiler furnaces. The different types and their characteristics and properties are summarized, and drawings of typical furnaces with refractories in place are shown. Standard sizes and shapes of brick are illustrated with their dimensions, with tables and formulas for arch construction.

428 WARM AIR SPACE HEATER

Dravo Corp., Machinery Div., Heating Dept.—A light oil fired warm-air heater, known as the Paraflo Space Heater and manufactured in two models, the Model 20 with 200,000 Btu/hr output and the Model 25 with 250,000 Btu/hr output, is described in Bulletin No. 550. The completely automatic Paraflo Heater is equipped with an Underwriters' Laboratories approved gun-type oil burner. It is a self-contained unit, assembled and flame tested at the factory prior to shipment.

429 POTENTIOMETERS AND EQUIPMENT

G. M. Giannini & Co.—A set of bulletins covers potentiometers and equipment utilizing potentiometers. Bulletins are: Bulletin No. 111, Minitorque Model No. 8515S-85166S Potentiometer, a 0.25 oz.-in.-torque model; Bulletin No. 110, Logarithmic Output Potentiometer Models 85196-92 and 85196-94, 40-db and 50-db log output; Bulletin 109, Angular Position Encoder Model No. 14310 and 14311; Bulletin No. 108, Rectipot Model No. 8620 Potentiometer, linear motion, plunger-actuated; Bulletin No. 107-B, Universal Model No. 85196 Potentiometer, designed for computer and servo systems; Bulletin No. 106-A, Minigang Model No. 85193 Potentiometer, 1 1/8 in. in diameter, which can be used single- or multiple-section; Bulletin No. 105-A, Gangpot Model No. 85194 Potentiometer, a multiple-section unit with vernier phasing; Bulletin No. 102-B, Microtorque Model No. 85111-85126 Potentiometer, with a torque of 0.003 to 0.008 oz.-in.; Bulletin No. 101-B Spiralpot Potentiometer, with ±0.01 per cent linearity; Bulletin No. 301, Pressure Instrument Model 45176, potentiometer output; and Bulletin No. 201, Linear Accelerometer Model 24132S, potentiometer output.

Your NEW CATALOGS Guide offers readers of MECHANICAL ENGINEERING an opportunity to secure advertisers' latest industrial literature available. In this issue there are 429 items to make selections from. For convenience an index may be found on pages 41 and 42. Select desired catalogs by number, requests limited to 25 catalogs. Fill in coupon on page 42 and mail promptly. (*Must be mailed on or before date given on coupon.*)

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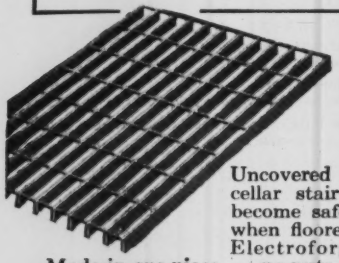
SAFE and USABLE
with this unique, one-piece
OPEN STEEL FLOORING



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SECURE!

Uncovered pits, light wells, cellar stairways, etc. quickly become safe and usable areas when floored with Blaw-Knox Electroforged Steel Grating. Made in one piece . . . no nuts or bolts to rattle or lose. Provides safe footing even when wet or greasy and lasts indefinitely. Admits maximum light and air. Furnished in any shape, cut to fit. Just send dimensional sketch of area to be covered and we will forward price by return mail.

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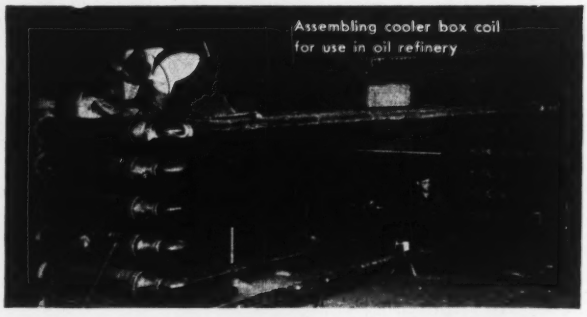
ELECTROFORGED® STEEL
BLAW-KNOX GRATING



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PIPING JOBS

No special piping design presents too great a challenge for Western Piping Supply's many specialists. Engineers, pipe benders, welders, or the men who align, heat treat, or test—all have the skill and good judgment bred of long experience. These men stand ready to handle all your pre-fabricated piping requirements, whether of special or conventional design.

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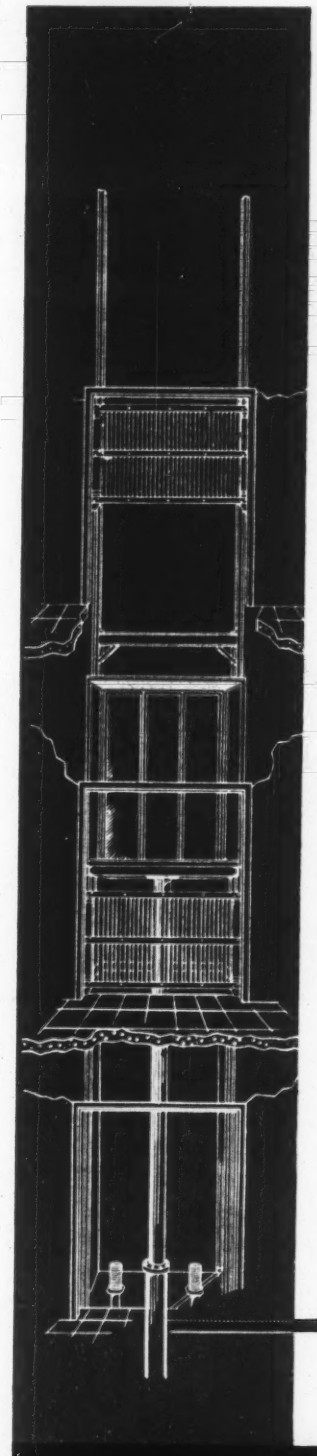

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BERRY PUMPS
reduce pulsation in hydraulic elevator installations

Customer proven BERRY units assure full 360° of smooth, positive hydraulic power

Berry pumps specially designed for passenger elevator installations represent the ultimate in efficient performance.

An exclusive continuous flow feature decreases pulsation to insignificance.

Berry-driven elevators are more quiet and more comfortable, and long-lived Berry units require a minimum of maintenance. Consult Berry engineers for recommendations on your own equipment. Sales engineering representatives in principal cities. Or write us for descriptive literature.

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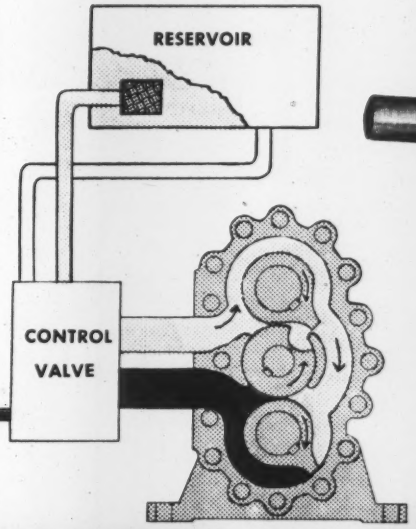
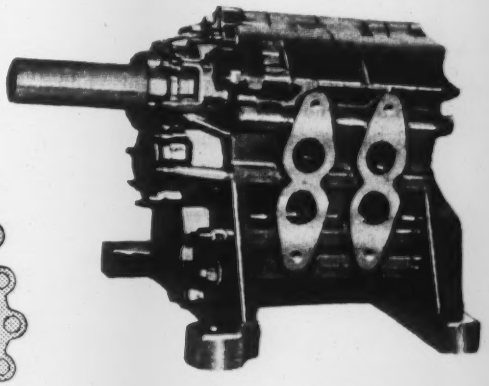
PRESSURES TO 500 P. S. I.

FULLY REVERSIBLE OPERATION





Shown is a Model 32-05 B2
For 120 gpm at 500 psi.

BERRY DIVISION
Trade Mark
OLIVER IRON AND STEEL CORPORATION
PITTSBURGH 3, PENNSYLVANIA

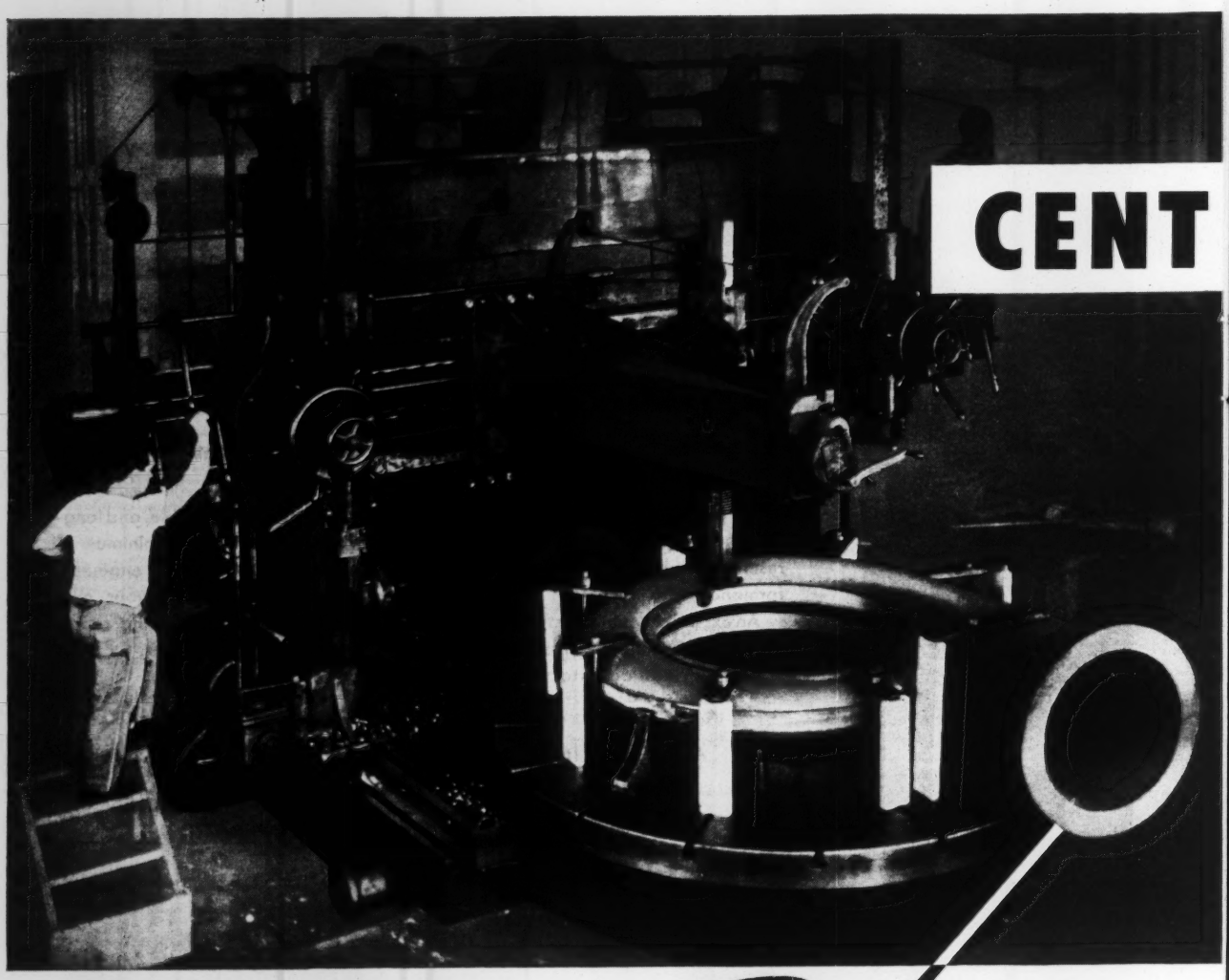
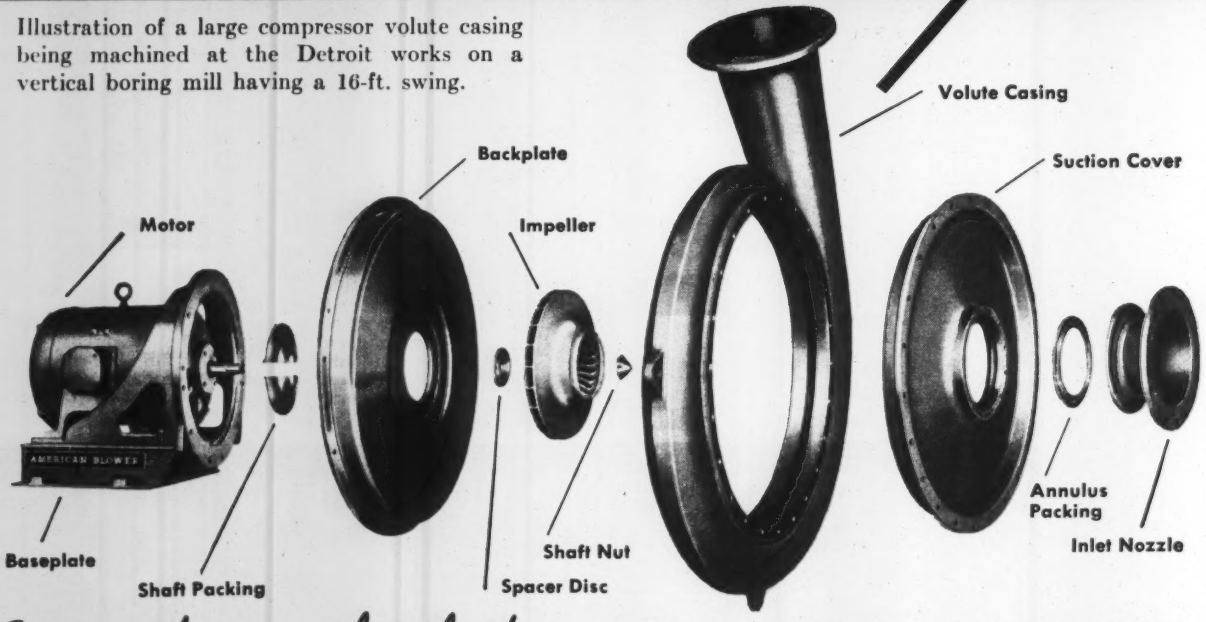


Illustration of a large compressor volute casing being machined at the Detroit works on a vertical boring mill having a 16-ft. swing.



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AMERICAN BLOWER

RIFUGAL COMPRESSORS

Single Stage Design
Sizes: 30 to 600 HP
Pressures:
1¼ to 3¾ lbs.

Take an excellent design, quality materials, modern machine tools, superior research and testing facilities, skilled engineers and craftsmen — and you have the important factors behind American Blower's outstanding line of centrifugal compressors. To you, this insures a quality product built and backed by a great name in air handling.

American Blower Centrifugal Compressors efficiently deliver large volumes of air or gases at high pressures. They're compact, require minimum foundations and are adaptable to all types of drives.

Next time you want bids on centrifugal compressors, why not call in American Blower, too? Contact our nearest branch office for preliminary technical data or write us for Bulletin 109.

Whether you need equipment for heating, cooling, ventilating, air conditioning, vapor absorption, fume removal, dust collecting, mechanical draft, heat transfer or smooth power transmission thru Gyrol Fluid Drives — American Blower manufactures a complete line of products to meet your requirements. Helpful technical literature is available on each product.

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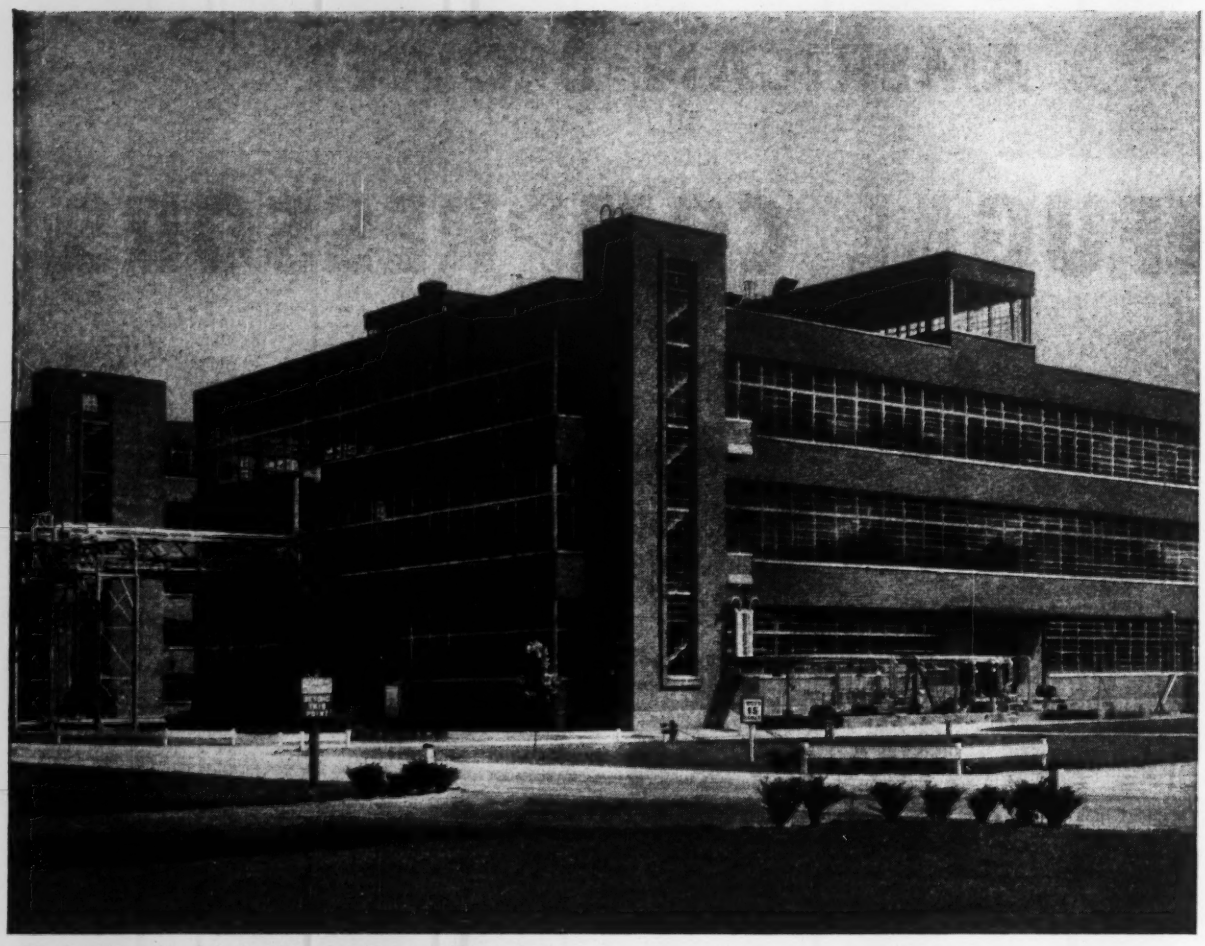


Wind and sun load don't affect working conditions here.

UNIT HEATING
SAVES FUEL COST

How do you economically heat a plant where the walls have more glass area than brick? That can be a real problem. Constantly changing wind and sun loads cause a central-plant system to overheat and underheat.

But the Tom's River Division of CIBA STATES LIMITED found the answer with unit heaters. They installed 200 Westinghouse Speedheaters throughout their three large buildings. The Speedheaters supply heat only as required. For CIBA: acres of sunlit workspace, winter comfort control, economical heating with low investment.

Are you building new quarters? Are your heating costs high? You'll save money with Westinghouse Speedheaters. Install them today. Write for Catalogs 1521 and 1525. Westinghouse Air Conditioning Division, Hyde Park 36, Massachusetts.

Westinghouse Speedheaters blanket large window areas. Separate control for each area provides the most efficient heating. Fan-driven air results in uniform temperatures throughout.

WESTINGHOUSE SPEEDHEATERS

YOU CAN BE SURE... IF IT'S **Westinghouse**

J-80339

Oh, I see

OIC VALVES at work in the power plant at Ford Motor Company.

THE CLEVELAND PLANT of the Ford Motor Company, showing the engine plant, foundry and power plant.

...they're using our valves at FORD

Ford cars are an example of true manufacturing efficiency. Ford buys only that equipment which can be relied upon to maintain or increase such efficiency.

OIC's Long Line of valves meets Ford's exacting specifications. They're used here on basic facilities and main piping systems for water, steam and air. Because they're precisely engineered for long, trouble-free service, OIC Valves can help you achieve maximum efficiency in control of flow. Write for catalog information or engineering assistance in selecting and applying valves.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC FOUNDED 881

VALVES | **FORGED & CAST STEEL, IRON & BRONZE, LUBRICATED PLUG VALVES**

COMPRESSOR CONTROL PROBLEMS?

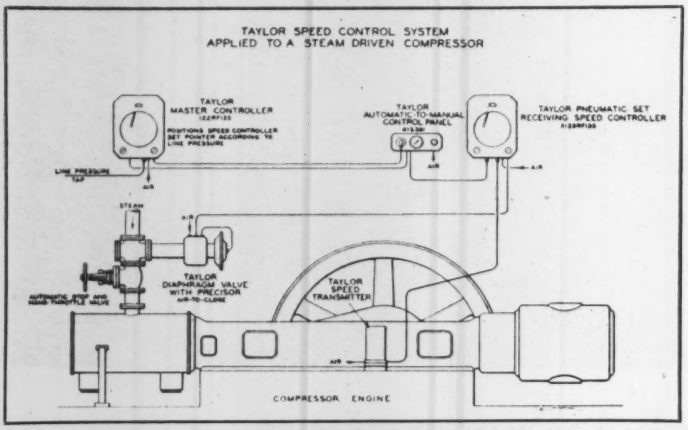
Taylor Speed Control gives better operating economy and processing quality for any type compressor or driver

Taylor Compressor Control Systems combine speed control to give you fully automatic control of compressors with direct relation to other variables in your process. These compressor control systems were developed by Taylor Engineers working hand in hand for years with leading compressor manufacturers and the ultimate user in refineries, gasoline plants and petro-chemical plants.

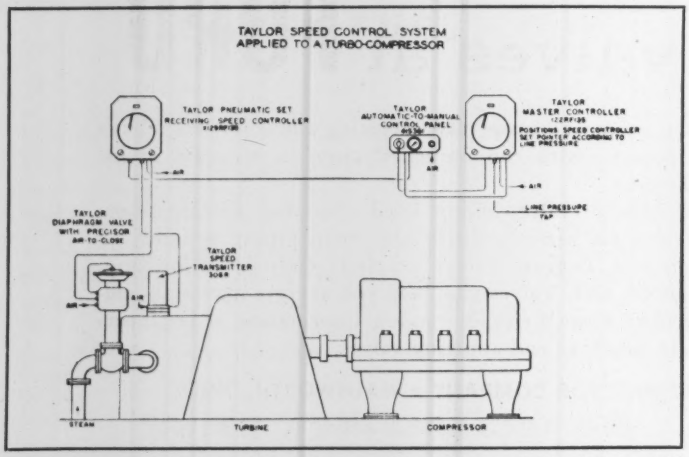
This all adds up to one important point. *When a compressor's function is closely controlled according to process requirements, substantial economies result from reduced fuel consumption as well as higher yields of quality end product.*

We can furnish a rugged, dependable control system for any type of driver and compressor combination. Ask your Taylor Field Engineer! Or write Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

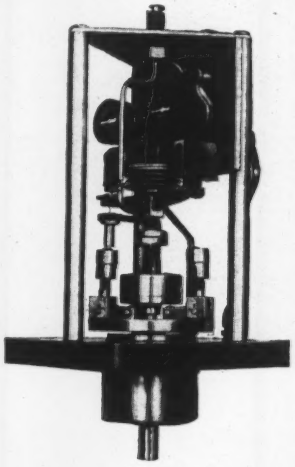
Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.


TAYLOR SPEED CONTROL SYSTEM
APPLIED TO A STEAM DRIVEN COMPRESSOR
TAYLOR MASTER CONTROLLER
TAYLOR AUTOMATIC-TO-MANUAL CONTROL PANEL
TAYLOR PNEUMATIC SET RECEIVING SPEED CONTROLLER
POSITIONS SPEED CONTROLLER SET POINTER ACCORDING TO LINE PRESSURE
LINE PRESSURE TAP
STEAM
AIR
TAYLOR DIAPHRAGM VALVE WITH PRECISOR AIR-TO-CLOSE
TAYLOR SPEED TRANSMITTER
COMPRESSOR ENGINE

On this Reciprocating Compressor Speed Transmitter teams up with Taylor Pressure Controller, Pneumatic Set Speed Controller and Diaphragm Valve to maintain desired process pressure at minimum operating cost.



Applied to a Centrifugal Compressor equal benefits are derived from this control system. Fuel consumption is held to a minimum, consistent with the maintenance of optimum process pressure.



Taylor Speed Transmitter permits use of standard controls!

Here's how it works:

It is a dependable force-balance transmitter working in combination with a Taylor FULSCOPE* pneumatic controller. The fly-ball operated transmitter is driven by the compressor and converts engine speed directly to output air pressure proportional to the square of the speed. This signal is received by a Pneumatic-Set FULSCOPE Controller which regulates the fuel valve to give desired speed control. Processing pressure requirements—measured and controlled by the master controller—determine the speed controller set point.

*Reg. U. S. Pat. Off.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

PUMPS for INDUSTRY

FLUID POWER PUMPS

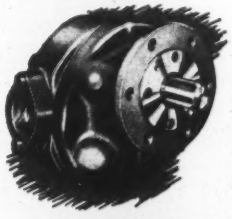
The most comprehensive range of types, capacities and pressures in Hydraulic Pumps for industrial equipment, presses, machine tools, materials handling, metal working, mobile equipment, mining, petroleum, gas and aviation applications. Hydraulic Pumps, Motors, Cylinders and Valves to develop complete Hydraulic circuits.

LIQUID HANDLING PUMPS

An exceptionally broad range of types, sizes and special constructions to handle virtually "any substance that will flow through a pipe" including: water, petroleum products, alcohols, syrups, acids, sludges, slurries, asphalt, bunker fuel, etc.

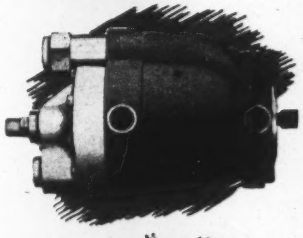
VACUUM PUMPS

High Vacuum Pumps for laboratory, electronic, atomic research, biological and other chemical processing, vacuum refining of metals, de-aerating, dehydration, vacuum drying, refrigeration.



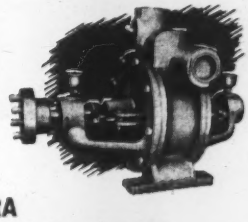
HYDRECO GEAR TYPE PUMPS

Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.



STRATOPOWER PISTON TYPE PUMPS

Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rpm with maximum of 4500 rpm . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.

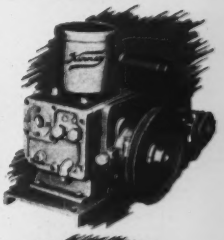


AURORA CENTRIFUGAL & TURBINE PUMPS

Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.

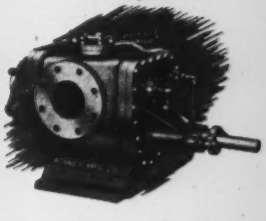
DUDCO DUAL VANE TYPE PUMPS

DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in dual units operating from a single drive. Hydraulic motors with starting torque outputs to 14,400 lb. in.



KINNEY VACUUM PUMPS

Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.



KINNEY LIQUID HANDLING PUMPS

A complete range of sizes in Rotating Plunger and Herringbone Gear Pumps to handle light or heavy liquids from gasoline to molasses. Available in plain or steam jacketed models.

THE NEW YORK AIR BRAKE COMPANY
230 PARK AVENUE • NEW YORK 17, N. Y.

THE NEW YORK AIR BRAKE COMPANY
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Gentlemen: Kindly send me additional information on:
Hydraulic Pumps ☐ 1000 psi ☐ 2000 psi ☐ 3000 psi Liquid Handling Pumps ☐ Vacuum Pumps ☐

Name.....

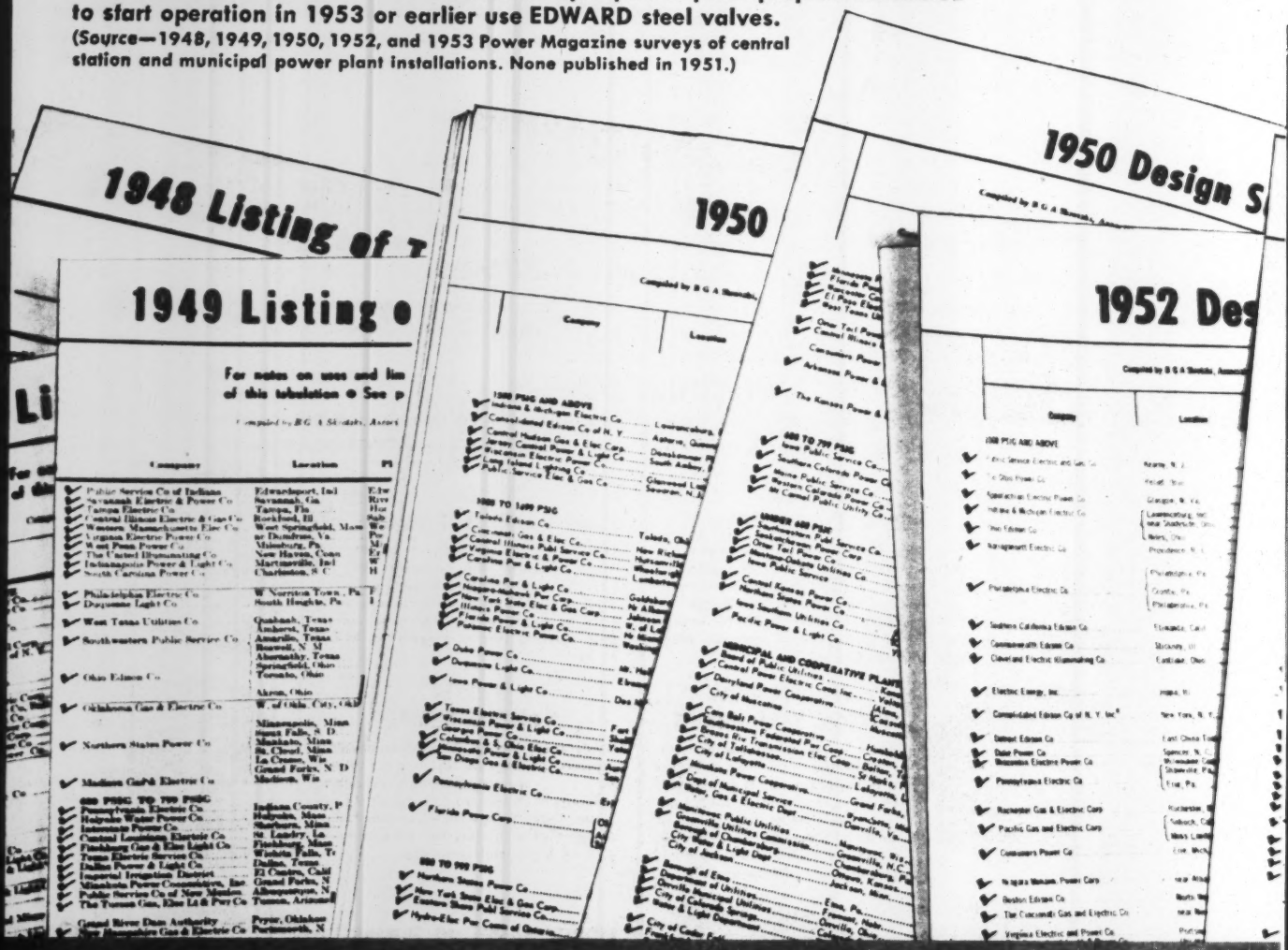
Address.....

City..... **State**.....

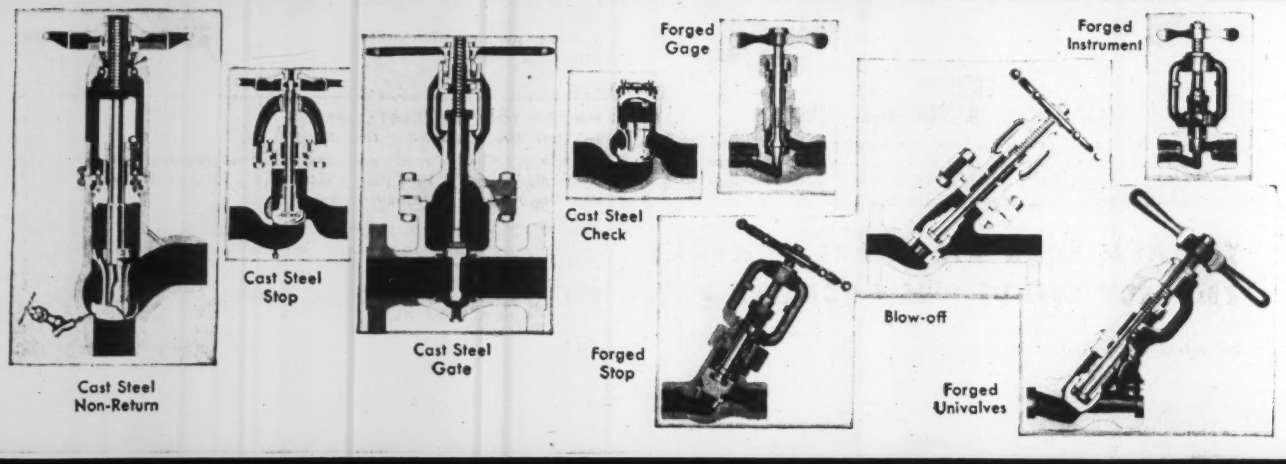
Again it's Edward Valves in over

THE EVIDENCE: **575 out of 598 (96.15%) of new central station and municipal power plant projects scheduled to start operation in 1953 or earlier use EDWARD steel valves.**

(Source—1948, 1949, 1950, 1952, and 1953 Power Magazine surveys of central station and municipal power plant installations. None published in 1951.)

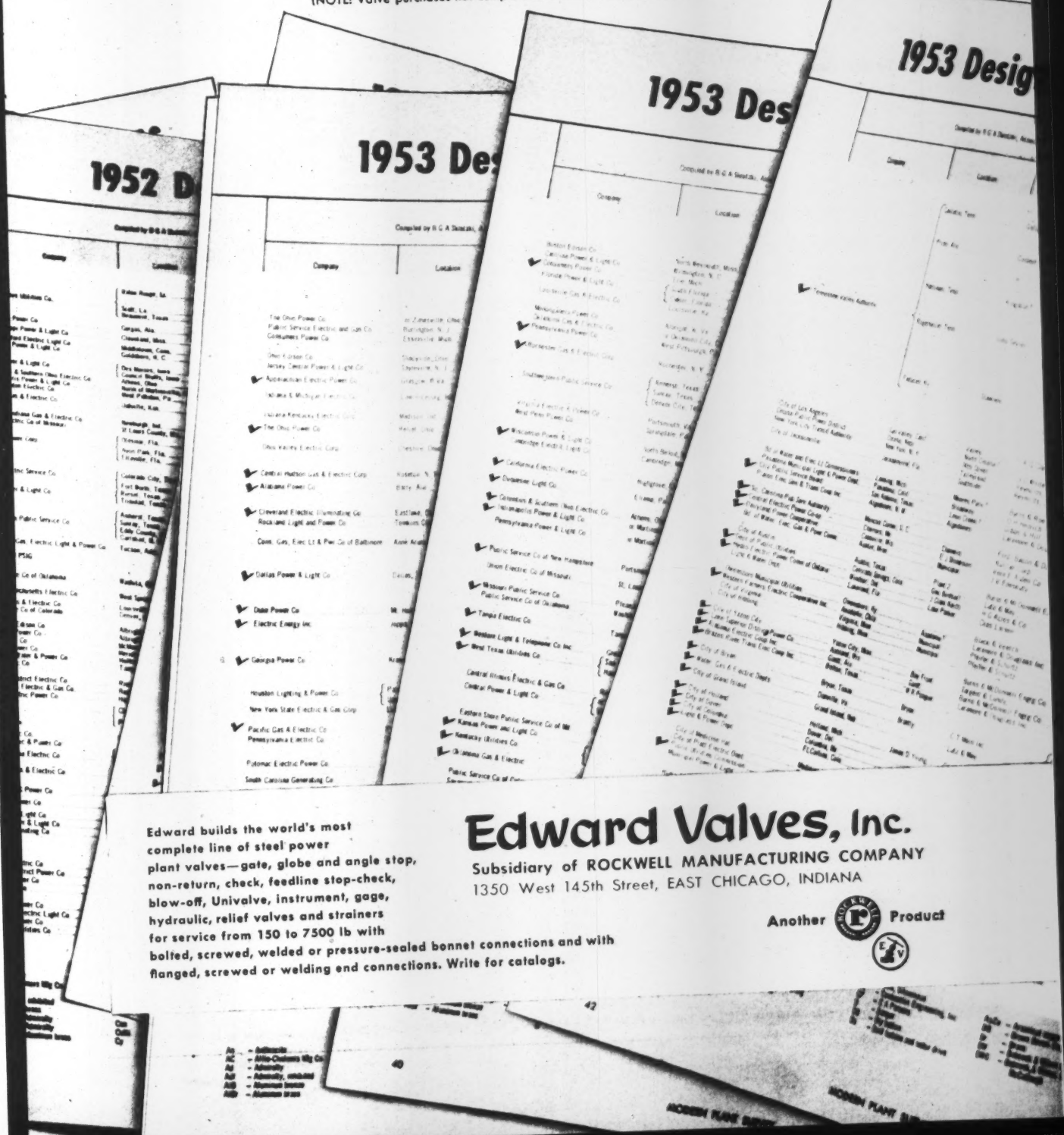


TYPICAL EDWARD DESIGNS GOING INTO NEW STATIONS



96% of new power plant projects

✔ INDICATES PLANT USING EDWARD VALVES
(NOTE: Valve purchases not completed for many plants on 1953 list)



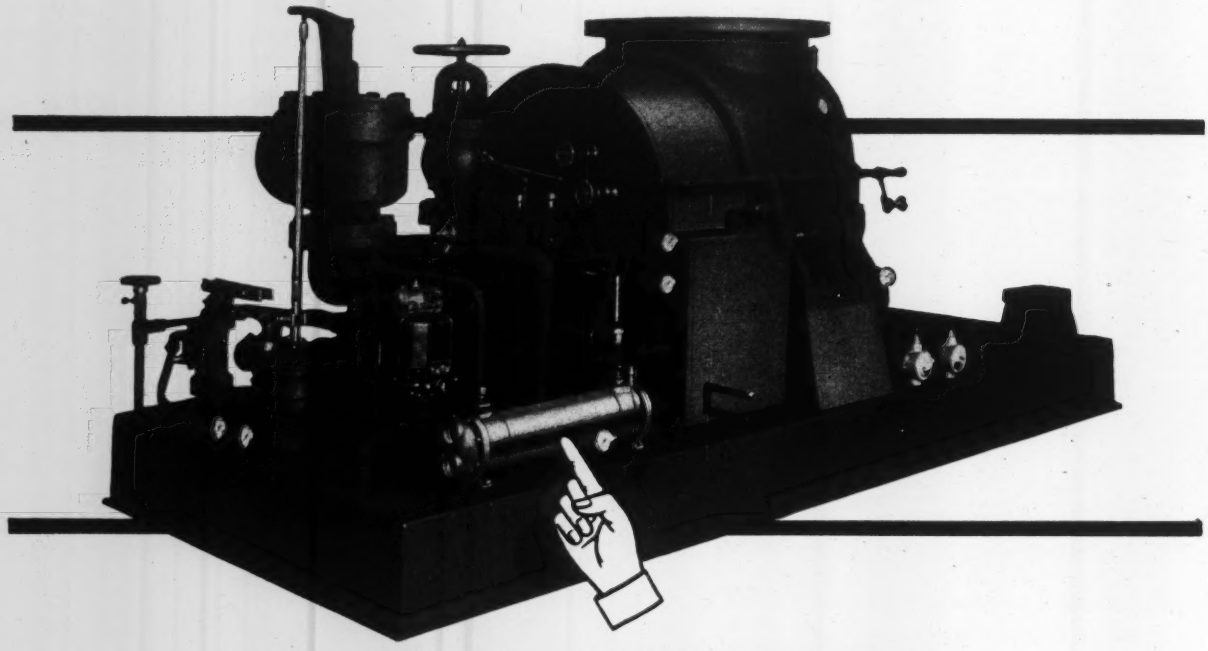
Edward builds the world's most complete line of steel power plant valves—gate, globe and angle stop, non-return, check, feedline stop-check, blow-off, Univalve, instrument, gage, hydraulic, relief valves and strainers for service from 150 to 7500 lb with bolted, screwed, welded or pressure-sealed bonnet connections and with flanged, screwed or welding end connections. Write for catalogs.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
1350 West 145th Street, EAST CHICAGO, INDIANA

Another Rockwell Product

keeping oil temperature at proper operating level in this Terry Turbine



A ROSS EXCHANGER

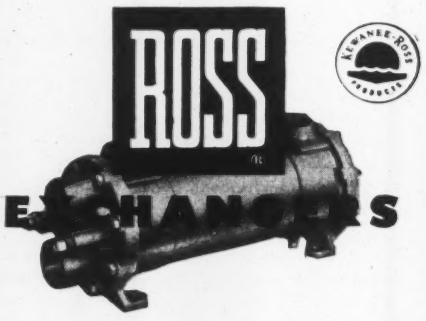
Driving a centrifugal compressor in demanding refinery service, this Terry Multi-Stage Turbine is rated 2700 hp at 8500 rpm. To provide oil temperature control for the unit's variable speed oil relay governor, main journal and thrust bearings, The Terry Steam Turbine Company factory-installed a Ross Type BCF Exchanger. An adequate supply of dependably cooled lube oil, at correct viscosity, is thus assured at all times.

Regularly written into specifications where high thermal efficiency and extreme ruggedness are of prime importance, Ross Exchangers are widely preferred throughout the oil and gas industry as standard components of engines, compressors, speed increasers, transformers and hydraulic equipment.

Pre-engineered, fully standardized, all copper and copper alloy Ross Type BCF Exchangers are stocked in a wide range of sizes to meet most requirements . . . *promptly*.

Detailed information is in Bulletin 1.1K5. Write.

KEWANEE-ROSS CORPORATION
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
1448 WEST AVENUE • BUFFALO 13, N. Y.
In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.



Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

In the almost quarter century that we have been in business, we have been called upon to develop and produce many highly specialized types of expansion joints. None, however, have been more spectacular than the 109-inch joints recently developed for use in testing equipment for aircraft engine prototypes. These low pressure joints were designed with a hundred internal tie bars, which permit the joints to absorb the lateral deflection between a long exhaust header, operating at 650° F. and a series of large gas coolers, without the need for heavy anchors. Eight of these joints are now in service in a classified defense project.

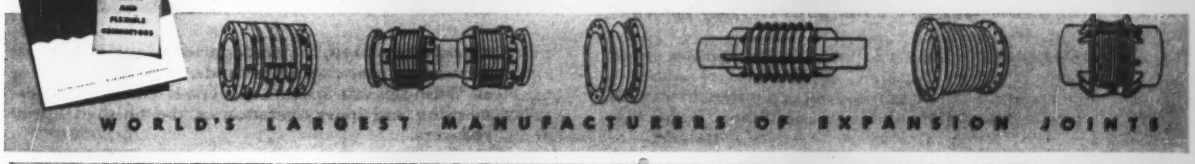
This is just another example of how Zallea engineers, with the experience gained from specializing in one product—expansion joints, are able to successfully and economically solve the most difficult problems confronting this type of industry.

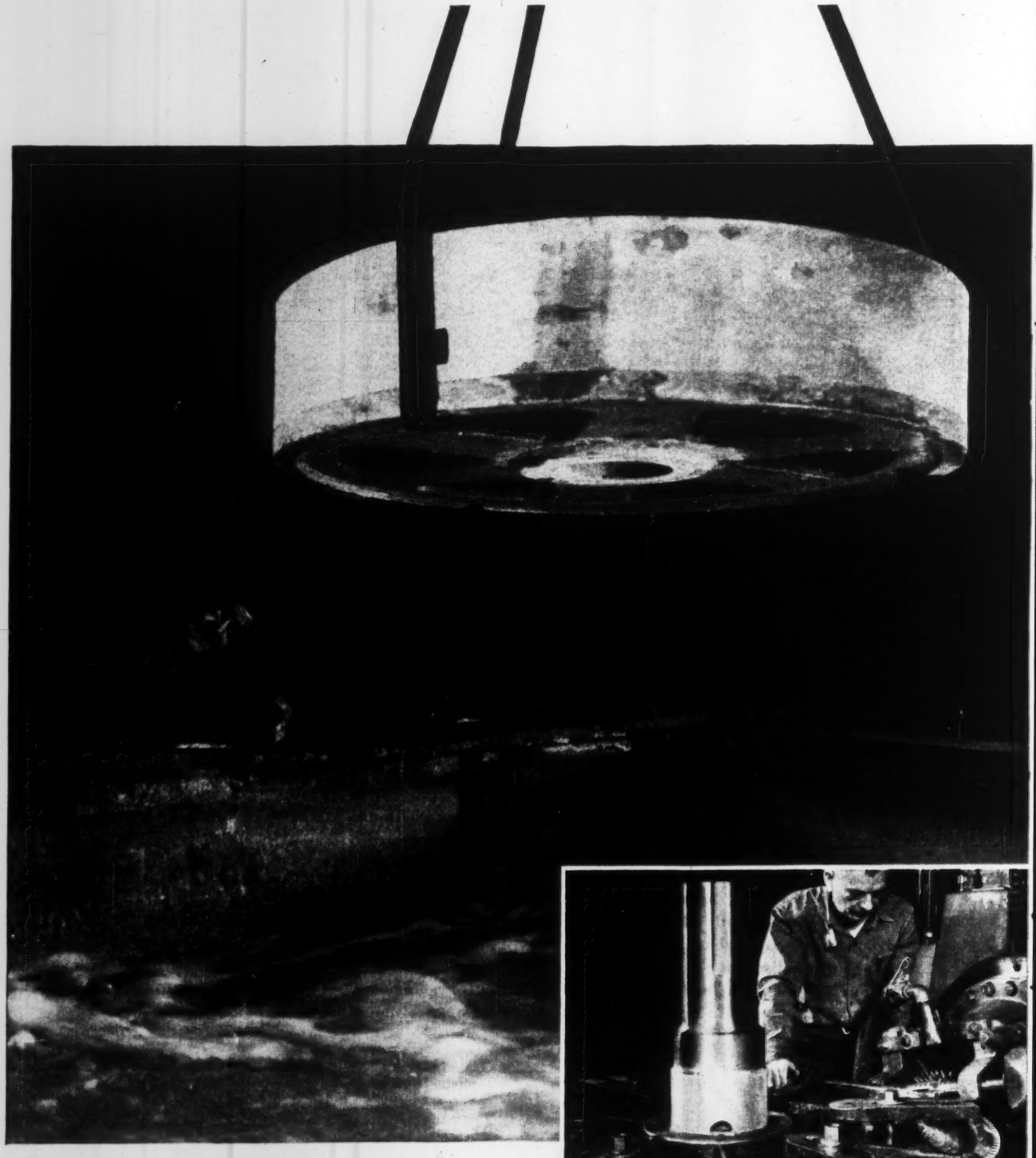
But this is not all—we regularly manufacture a complete line of expansion joints capable of service in virtually any type of expansion application. These joints are available in diameters from 3 inches to 30 feet for temperatures from subzero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs and up to 2,000 psi in special designs.

For full details regarding your expansion joint problems or requirements, just get in touch with us. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

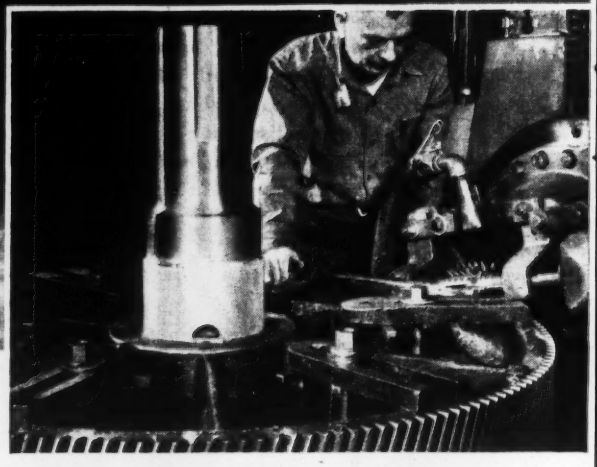
For detailed information on
Zallea Expansion Joints and services
write today for a free copy of Bulletin 351.

Zallea
EXPANSION JOINTS





After heating, all Westinghouse Gear Blanks receive this quenching in an exclusive BPT solution. Gears so processed have a tapered hardness from surface to core—absorb the shocks of everyday service.



The hobbing process, long recognized as one of the most accurate of gear-cutting methods, is used on gears for all Westinghouse Speed Reducers. It assures true gear meshing and quiet operation of the finished speed reducers.

Do your speed reducers have the added value this precise manufacturing assures?

Are you getting toughness, stamina, long life? These are qualities of Westinghouse Speed Reducers which stem from the step-by-step precision that goes into their making.

Westinghouse Gear Blanks, for instance, are made from high-quality steel that's thoroughly checked for conformity to specifications. Gears are hob cut which means precision cut. They're heat-treated by an exclusive Westinghouse BPT process that carefully tapers gear hardness from surface to core. It's your assurance of gear teeth that will resist surface wear yet absorb the many shocks of service.

Antifriction bearings on all Westinghouse Speed Reducers lessen friction loads—especially on starting. They maintain precise gear center distance. The result —permanent alignment and minimum friction loss.

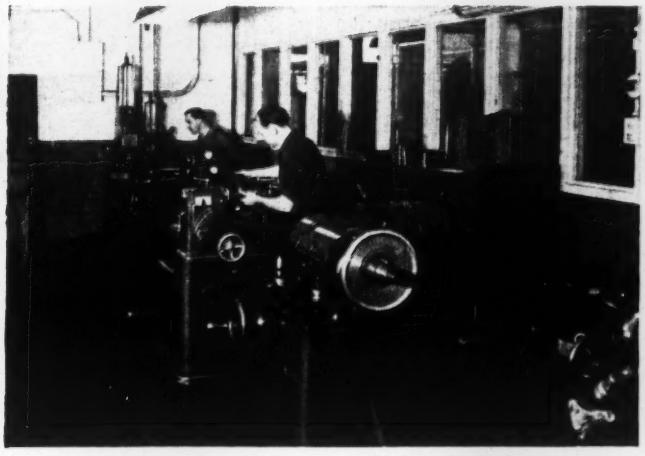
The rugged cast iron gear case is made in two sections for ready accessibility of all working parts. Thus servicing is greatly simplified. Ribbing, provided at points of greatest stress, gives extra strength and rigidity with proper alignment of parts maintained at all times.

These features, together with many others that are designed, manufactured and tested to meet rigid Westinghouse standards, are the result of over sixty years' experience in the design and manufacture of gearing. This adds up to speed reducers that give year-in, year-out, trouble-free performance. Investigate the full line of Westinghouse Gearing Equipment wherever speed reduction is required. Your local Westinghouse representative will be glad to furnish any information. Call on him at any time or write, Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

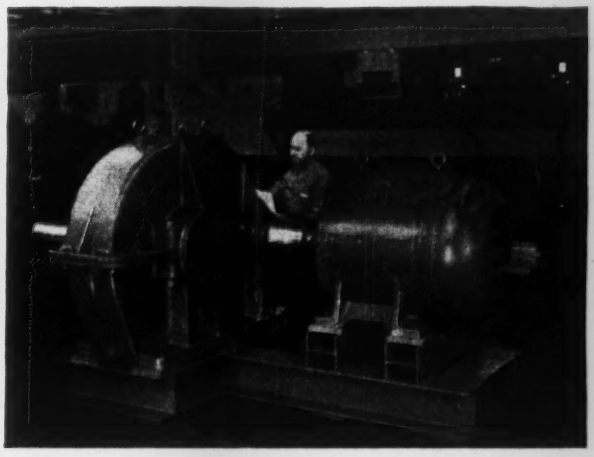
J-07332

YOU CAN BE **SURE**...IF IT'S

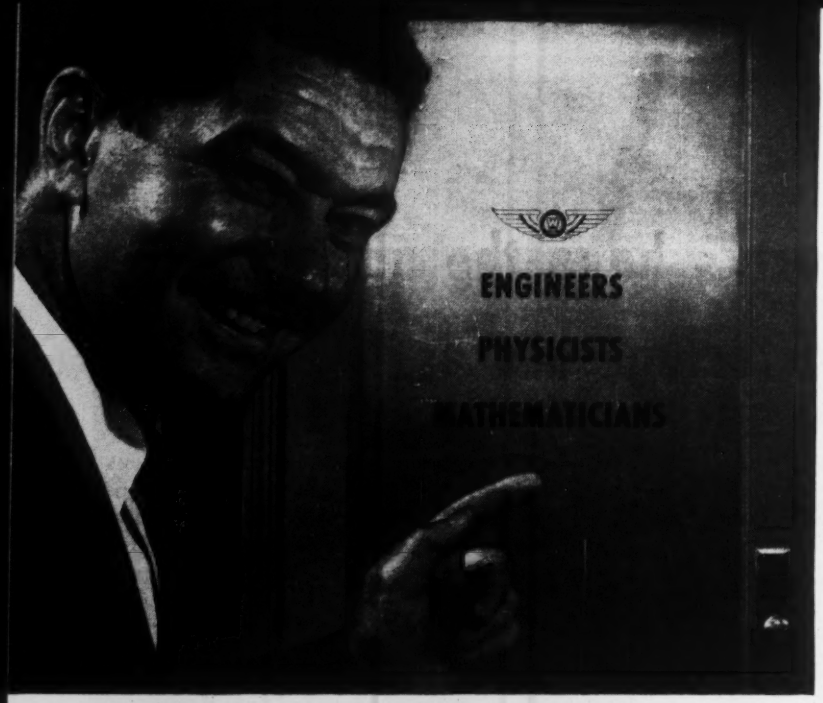
Westinghouse



All machined parts are thoroughly inspected at each step of manufacture to assure the high degree of accuracy necessary for smooth operation. Hobs and other tools are also checked repeatedly to control uniformity of gears produced.

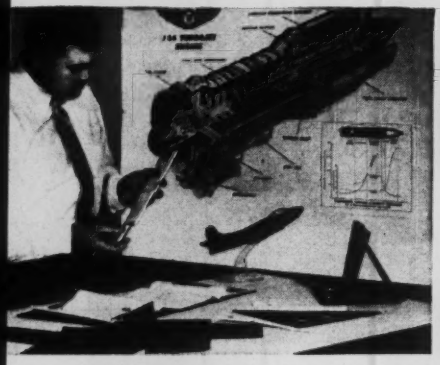


Before shipment, each complete speed reducer is given a running test under load. These tests enable Westinghouse to determine in advance the performance of each unit under conditions approximating actual service.

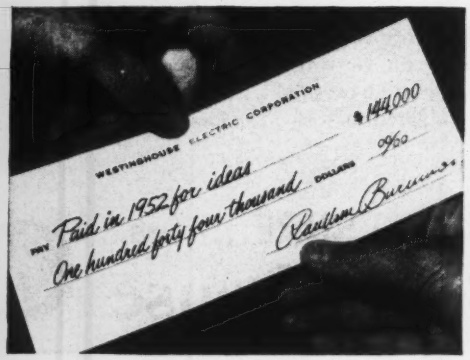


Look at these new opportunities in jet engineering at Westinghouse

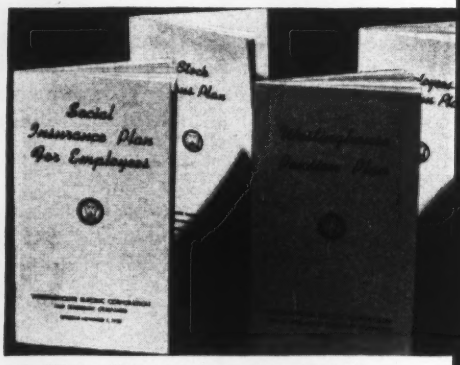
1. Immediate openings in research, development and manufacturing at our Aviation Gas Turbine Division in Philadelphia or Kansas City, Mo. Salaries are good, varying with experience and ability. You'll enjoy working with us.



2. Challenging work offers the opportunity of joining with Westinghouse, a long-time leader in jet engineering.



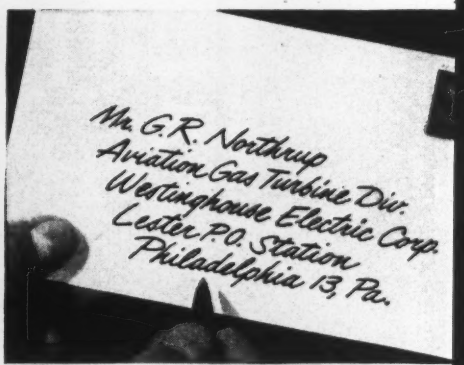
3. Incentive awards are given for inventions and ideas. Creative work is recognized and rewarded. We even pay your tuition for graduate study.



4. "Extras" include a modern pension plan; low-cost life, health, and accident insurance; stock purchase plan.

5. Security we consider important. Promotion is from within. We're in this new, expanding industry to stay.

6. Living conditions in Philadelphia and Kansas City suburbs are good with easy access to recreational activities. We will help you find housing.



7. Write today to this address; send full details. We'll arrange for a confidential interview for all qualified applicants.

J-54023

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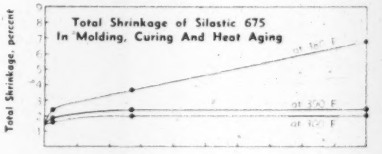
DOW CORNING

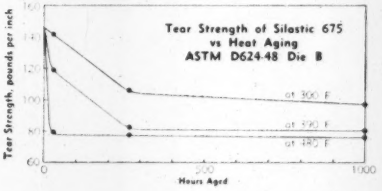
Silicone News

No. 3 of a Series • PUBLISHED BY DOW CORNING CORPORATION, MIDLAND, MICHIGAN

Remarkably Low Compression Set And Low Shrinkage Characterize New Extreme Temperature Silastic*

Silastic 675, a newly developed molding stock, has a combination of properties that is unique even among silicone rubbers. Serviceable from —100 to 500 F, Silastic 675 exhibits the lowest compression set of any extreme temperature silicone rubber. After 22 hours at 300 F, for example, compression set of this new molding stock is in the range of 15 to 20%; after 70 hours, 20 to 28%.





Silastic 675 is well suited for use in applications where low shrink in service is essential. Total shrinkage of molded test samples is below 2.5% after 1000 hours at 400 F; less than 7% after 1000 hours at 480 F. This low shrinkage characteristic also makes it possible to fabricate parts for many applications in the same molds used to form conventional organic rubber stocks.

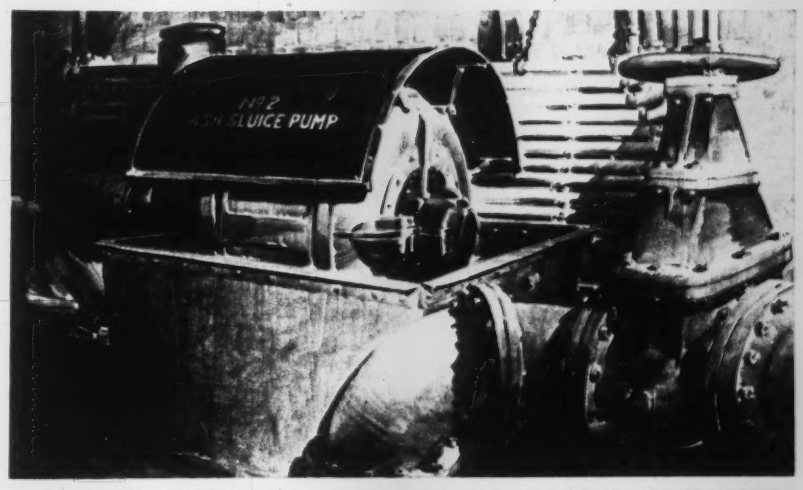
Silastic 675 also has good dielectric properties. Dielectric strength is 550 volts per mil. Measured at 10^2 cycles, dielectric constant is 3.07 and power factor is 0.0032. After seven days at 25 C and 100 percent humidity, surface resistivity of Silastic 675 is 2.82 at 10^{13} ohms and volume resistivity is 8.58 x 10^{13} ohms.

In addition to its low set, low shrink and excellent dielectric properties, Silastic 675 contains no toxic additives. It can safely be used to fabricate parts which come in contact with cosmetics, food and pharmaceuticals.

Silastic 675 is therefore singularly well suited to the fabrication of resilient gaskets, seals, O-rings, bellows, switch boots and dielectric fittings and connectors. It is one of the most versatile silicone rubber stocks available. It also opens new markets that have been inadequately supplied with parts molded of either organic or silicone rubber stocks.

No. 22

* T. M. REG. U. S. PAT. OFF.



WORLD'S LARGEST UTILITY COMPANY SPECIFIES SILICONE (CLASS H) INSULATION FOR RELIABILITY

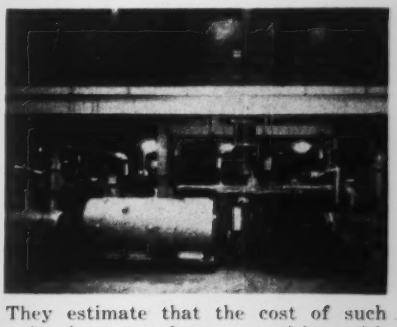
When millions of customers depend on you for 24 hour a day service, you can't take chances with your equipment. That's why the Consolidated Edison Company of New York took action when a 350 hp Class A insulated sluice pump motor failed three times in one year.

Although repeated overloading was the primary cause of failure, ambient temperatures were kept high by an enclosure built around the motor for flood protection. Failure rate was cut to once a year by rewinding with Class B insulation. The motor was then rebuilt with Class H insulation made with Dow Corning silicones. That was 9 years ago, and it is still in service.

That was Consolidated Edison's first experience with Class H insulation. Since then, many other motors have been rewound with Class H to withstand tough operating conditions. Over 79% or 71,700 out of a total of 90,500 horsepower in new motors bought for major auxiliary installations have been Class H insulated.

In buying new Class H equipment, they found that the frame size of motors rated at 200 hp or more could be reduced to such an extent that manufacturing economies often resulted in getting the added life and reliability of Class H insulation at no increase in total cost. Many solenoid coils and replacement coils for motors are also insulated with Class H materials.

Consolidated Edison has also pioneered the use of Class H insulation in sealed dry-type unit substation transformers.



They estimate that the cost of such units is more than competitive with conventional installations for power plant auxiliary supply. Convenient and safe, the Class H transformers can be located almost anywhere. And the cost of cable, switchgear, fire protection and related equipment is greatly reduced. That's why Consolidated Edison has already bought eighty-one 1250 KVA Class H transformers for unit substation work, and twelve 1000 KVA units for miscellaneous light and power.

Continued pg. 2

(ADVERTISEMENT)

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MORE

DOW CORNING Silicone News

NEW DEVELOPMENT AND TECHNICAL DATA

For copies of any of the publications reviewed in this column or for data relating to any of the articles printed in this issue of the Dow Corning Silicone News, simply circle the corresponding reference number on the coupon below.

New pressure sensitive adhesives that stick to almost any material remain serviceable and can be applied at temperatures from —67 to 480 F. Uses include bonding silicone treated electrical insulating materials, sealing and wrapping tapes and assembly of small electronic parts prior to mechanical installation. *No. 25*

●

A reprint from Precision Metal Molding magazine describes various applications of silicone die lubricants in metal fabricating. Article includes information on effectiveness, concentrations used and methods of application. *No. 26*

●

Heat-stable, nonflammable, foamed structures can be produced from two new Dow Corning expansible resins. Such structures resist direct flame and thermal shock; undergo practically no structural or dimensional change at 700 F; show less than 0.05 percent moisture absorption after 7 days at 96 percent relative humidity. Both resins can be expanded to densities of 6 to 24 pounds per cubic foot. *No. 27*

●

Leather footwear, linemen's belts and gloves, and sporting goods, treated with Dow Corning 1109, remain water repellent for long periods of time; show greater resistance to oils and many chemicals. Silicone water repellent treatment does not impair "breathing" characteristics of leather. *No. 28*

●

Over 80 rubber companies, ready to make Silastic parts to your specification, are included in a revised listing of Silastic Fabricators. *No. 29*

●

For dependable service under the severe operating conditions frequently encountered in power distribution, welding and electronic applications, Class H transformers may be obtained from the companies included in the list of nearly 100 manufacturers of Class H Transformers. *No. 30*

●

"Tall Tales and Fabulous Facts" is a new 24-page booklet in which a parallel is drawn between the tall tales our ancestors told about such legendary characters as Paul Bunyan, Davy Crockett and Pecos Bill and some of the equally fabulous facts about Dow Corning silicone products. *No. 31*

DOW CORNING CORPORATION - Dept. QI-11
Midland, Michigan

Please send me: 22 23 24 25 26 27 28 29 30 31

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COMPANY _____

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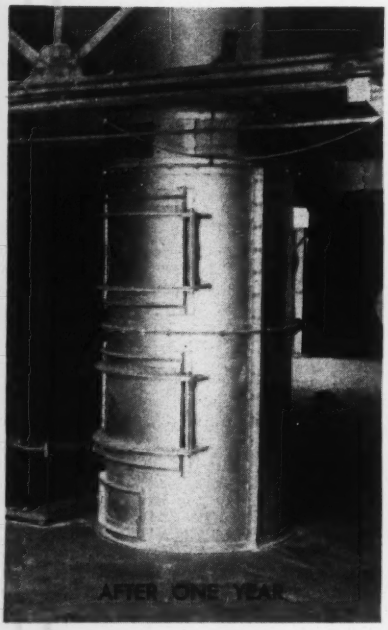
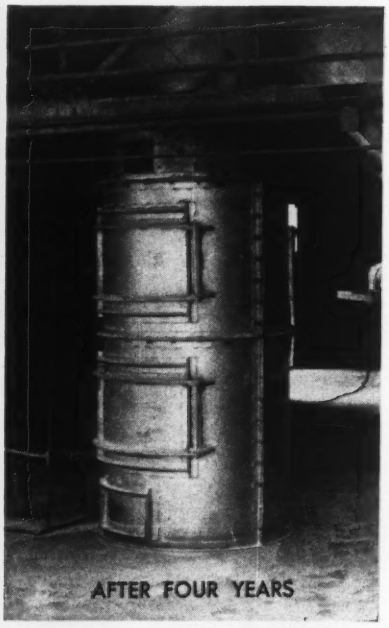
CITY _____ ZONE _____ STATE _____





Silicone Aluminum Finish On Cyclone Furnace Intact After 4 Years At Temperatures From 70 to 1400 F

In the manufacture of perlite, a lightweight plaster aggregate, Panacalite Pacific Inc., of Los Angeles expands crushed volcanic rock in a cyclone furnace. Originally the furnace stood outside, exposed to the weather. Four times a day it was charged, raising its surface temperature from 70 F to 1400 F.

Three different attempts were made to protect the furnace with aluminum pigmented organic paints. Each application failed completely in a few hours.

Then in December, 1949, the furnace and its hopper were sandblasted, treated with a phosphoric solution and painted with a silicone-aluminum finish, Dutch Boy No. 5542, formulated by the Pacific Coast Branch of the National Lead Company. Exposed to the weather for a year, including rain which fell when the surface was at peak temperature, the finish was still in excellent condition when a building was erected around the furnace and the photo at left was taken.

The second photograph was taken 3 years after the building was constructed. No repainting or other maintenance has been done to date. After 4 years service, the silicone based finish has suffered no visible deterioration or loss of film continuity. *No. 23*

CLASS H RELIABILITY *continued*

That's the attitude that a steadily increasing number of engineers and management men are taking toward Class H insulation made with Dow Corning silicones. Used to uprate equipment by as much as 50% or extend its service life more than 10 times, Class H gives maximum efficiency and maximum reliability at surprisingly little more cost than the next best class of insulation. *No. 24*

First in Silicones

DOW CORNING CORPORATION

MIDLAND, MICHIGAN

Atlanta
Chicago
Cleveland
Dallas
Detroit
Los Angeles
New York
Washington, D. C.
(SILVER SPRING, MD.)

In Canada: Fiberglas Canada Ltd., Toronto
In England: Midland Silicones Ltd., London

Manufacturers of
Silicone Fluids
Silicone Abhesives
Silicone Adhesives
Silicone Release Agents
Silicone Compounds
Silicone Greases
Silicone Water Repellents
Silicone Bonding Resins
Silicone Electrical Insulating Resins
Silicone Molding Compounds
Silicone Expansible Resins
Silicone Defoamers
Silastic

Why you can *lower inspection costs* with a Kodak Conju-Gage Gear Checker

Why the composite check

The composite check recommended in American Standard B6.11-1951 tests gears functionally by running the gear against a master of known accuracy. The resulting displacement shows at once the cumulative effect of as many as six types of error—eliminates time-consuming checks for each individual error. The check is rapid and conclusive.

Why the Kodak Conju-Gage Gear Checker

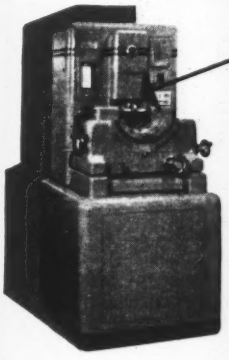
To meet today's tolerance requirements, the Kodak Conju-Gage Gear Checker uses a master made with a new order of precision. This is the Kodak Conju-Gage Worm Section, produced by thread grinding under control of a precision lead screw.

The accuracy inherent in this method means every right gear is passed by the worm section, reducing rejection losses. The transverse curvature produced by this method provides a master that can be used to check any gear of like pitch and pressure angle, regardless of helix.

Not only can a single worm section be used in place of a number of circular masters, but such a worm section can be reground to specification as often as necessary—at a fraction of replacement cost. It is easily checked for accuracy by familiar toolroom procedures.

You can find out more about the economies possible through Kodak Conju-Gage Instrumentation by sending for a copy of the booklet, "Kodak Conju-Gage Gear Testing Principle." Write to:

Special Products Sales Division
EASTMAN KODAK COMPANY
Rochester 4, N. Y.



The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variations, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 4U, for gears up to 4⅛" pitch diameter. Larger and smaller models are also available.

CONJU-GAGE INSTRUMENTATION

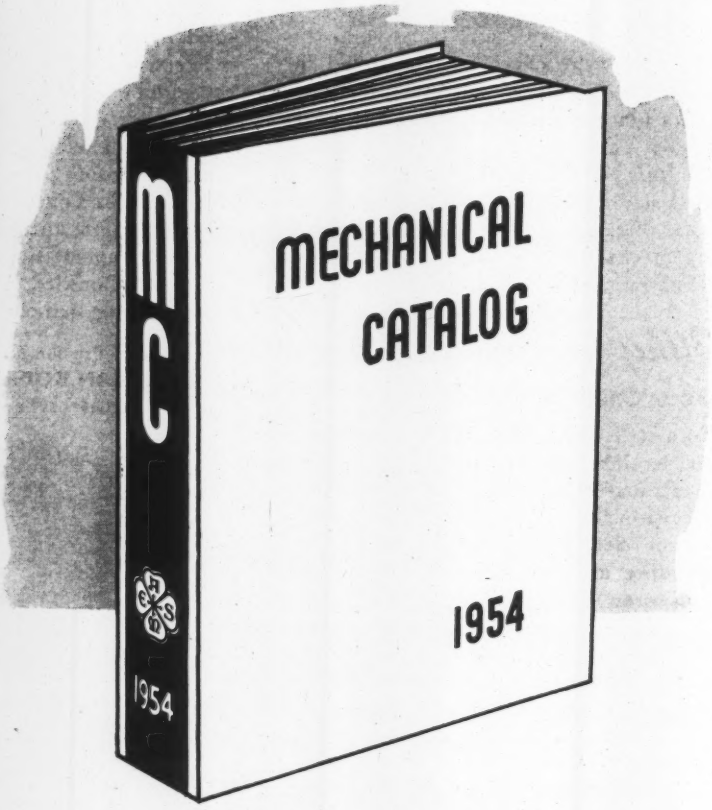
... a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak

Just Issued!

The New 1954 MECHANICAL CATALOG



Coming your way, housed in a new cover designed for ease in recognition is your new 1954 MECHANICAL CATALOG. More than 4,500 manufacturers co-operated in bringing you up-to-the-minute information on 6,000 products in over 50,000 listings, plus 342 pages of illustrated details to provide the specific data you need to guide the selection of engineered products.

Cross indexed to save valuable time in locating suppliers of anything from absorbers to zinc oxides, MECHANICAL CATALOG has proved its usefulness to engineers since 1911.

If you haven't already reserved your copy, do so now, the supply is limited.

Another service by ASME for its members!

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street, New York 18, N. Y.

Mr. C. E. Davies, Secretary

Please send me a copy of the 1954 MECHANICAL CATALOG. I have not previously requested a copy of the 1954 edition.

NAME.....

TITLE.....

COMPANY.....

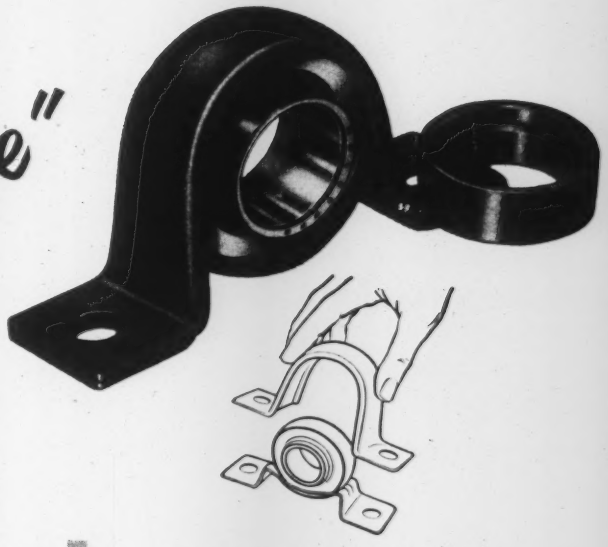
BUSINESS ADDRESS.....

.....

ANOTHER NEW FAFNIR...

Ball Bearing "Economy Package"

Type PB
Pressed Steel
Pillow Block



The new Type PB Series Pillow Block is developed to fill a specific need for a high-quality, precision ball bearing unit at the lowest possible cost. It is made for *light duty* applications where a low-cost "packaged" unit offers definite manufacturing and servicing advantages . . . on agricultural equipment, conveyors, light-duty fans and similar types of machinery involving the transmission of power.

The Type PB Series Pillow Block opens up new opportunities to add extra product sales features and to lower maintenance costs . . . another example of the Fafnir "attitude and aptitude". Send for new, descriptive bulletin. The Fafnir Bearing Company, New Britain, Conn.

OUTSTANDING FEATURES

- Low Cost
- Precision Ball Bearing . . . Fafnir Wide Inner Ring Bearing* with Self-locking Collar and efficient Plya-Seals.
- Two-piece separable pressed-steel housing.
- Self-aligning . . . unrestricted in all directions at assembly.
- Occupies less space than other pillow blocks.
- Light weight . . . combined with ample strength.
- Only two bolt holes required in assembly.
- Ample capacity for radial, thrust or combined loads.
- Pre-lubricated with long-life grease.
- Available for shaft sizes ½" to 1¼" inclusive.

*Easiest bearing of all to install. Counterbored, eccentric, mated cam construction of collar and inner ring assures positive locking action without set screws, lock nuts or adapters.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

So hard it cuts glass . . .

This striking photo demonstrates the extraordinary hardness of silicon carbide. As seen through a pane of glass, an exceptionally hard material itself, a chunk of natural silicon carbide crystals easily cuts the glass. That's why lining materials of silicon carbide are so highly resistant to wear.

Close to the diamond in hardness, silicon carbide is the . . .

Most Versatile, Wear-Resisting Material

Unique among man-made materials, silicon carbide offers exciting possibilities in applications where severe wear is a problem. Resistance to impinging solids, to corrosion, and to heat shock are some of its features . . . along with high load-carrying capacity.

Even under the toughest conditions of wear known, our CARBOFRAX® silicon carbide refractories have repeatedly outlasted special alloys and other materials generally considered to be highly durable. *This applies to room-temperature applications as well as to others ranging to above 3000 F.* It applies to wear caused by rubbing or sliding, and to wear caused by impingement of sharp particles traveling at high velocities.

For example: *In coke chutes and hoppers* that must withstand punishing cascades of sharp-edged coke . . . *in hot blast mains, blast furnace downcomers, and cyclone dust collectors* where abrasive dust is entrained in high-velocity gases . . . *in reheating furnaces* where metal slabs are pushed over skid rails or directly across the floor.

CARBOFRAX refractories are made in various thicknesses — are available as special, close-tolerance shapes, and as standard brick. They can also be supplied with interlocking joints. The coupon below will bring complete information. Why not check up? See how this unusual material can give real "armor-plate" protection.

CARBORUNDUM

Registered Trade Mark

Dept. P-113, Refractories Division
The Carborundum Company
Perth Amboy, N. J.

Please send descriptive data to:

Name_____

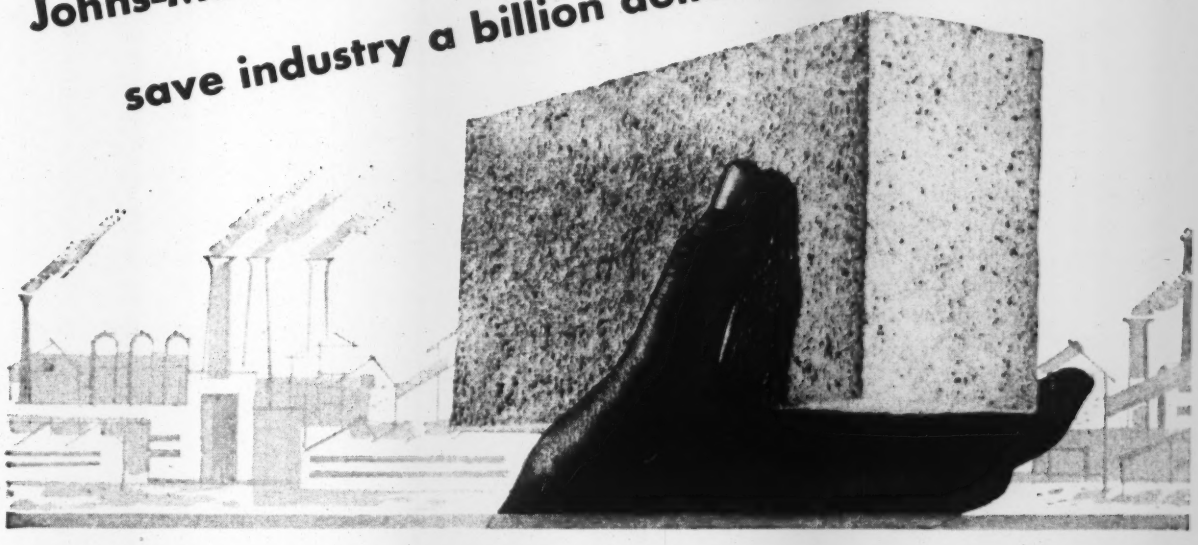
Position_____

Company_____

Street_____

City_____ Zone_____ State_____

Johns-Manville Insulations save industry a billion dollars in fuel every year!



Reduce your fuel costs and build better furnace linings with JM-3000 INSULATING FIRE BRICK

HERE'S THE ONLY insulating fire brick that withstands a full 3000F. It's highly efficient both as an exposed refractory lining or as back-up insulation. And JM-3000 is only one of six types of Johns-Manville Insulating Fire Brick made for these applications. All provide long-life insulation. All are light in weight, have low conductivity, high structural strength. These properties permit thinner furnace walls—yet you can achieve important fuel savings and increased production, because J-M Insulating Fire Brick assures quick furnace response.

Sil-O-Cel* Insulating Brick is another outstanding J-M fuel-saver . . . a high load-bearing brick for back-up insulation behind refractory linings. It comes in three types, for service through 2500F—makes it possible to reduce the necessary thickness of refractory linings as much as one-third.

Save fuel with J-M Hydraulic Setting Refractories

Johns-Manville refractories meet every need for castable, troweling and gunning applications for temperatures through 3000F. *Firecrete** is used to cast special shapes of all kinds. It is ready for use within 24 hours, has negligible shrinkage and high resistance to spalling. *Blazecrete** is used to build and repair furnace linings. When gunned, it adheres readily with a minimum of rebound loss. When slap-troweled, it eliminates laborious ramming and tamping.

Save Fuel with J-M Aggregates and Fills

These lightweight insulations are used as fills to conserve heat in irregular spaces where other forms of insulations cannot be economically applied. They are also used as aggregates for mixing with other materials to form insulating refractory concrete.

*Reg. U. S. Pat. Off.

Send for your free copy! This new booklet IN-115A gives full details about J-M insulating materials for service through 3000F. To find out how they can help cut your fuel costs, simply mail coupon.

JOHNS MANVILLE JM PRODUCTS

Johns-Manville FIRST IN INSULATION

Johns-Manville, Box 60, N.Y. 16, N.Y.
(In Canada, 199 Bay St., Toronto 1, Ont.)
Please send me, without charge, copy of brochure IN-115A

Name_____

Company_____

Street_____

City & Zone_____ State_____

THIS INSUL-MASTIC COATING COST NOTHING...

...it actually paid for itself in one year

The photograph shows INSUL-MASTIC TYPE "D" being applied on an oil tank that is kept heated to retain free flowing viscosity. Within one year after the completed application this coating of INSUL-MASTIC TYPE "D" prevented enough heat from escaping from the tank to pay for the cost of the coating. It also prevented corroding of the tank.

INSUL-MASTIC TYPE "D" is a *Superior* quality corrosion preventive coating to which we add considerable cork. We then apply it ¼ inch thick. It is not intended to replace standard thermal insulation, but on vessels where moderate temperatures are maintained it stops much heat loss while preventing corrosion.

Applications as old as fifteen years have never required maintenance.

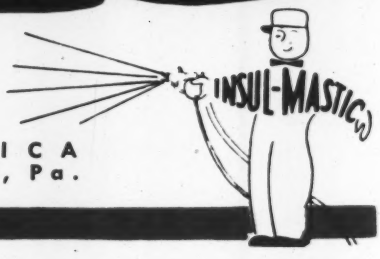
Write for further information.

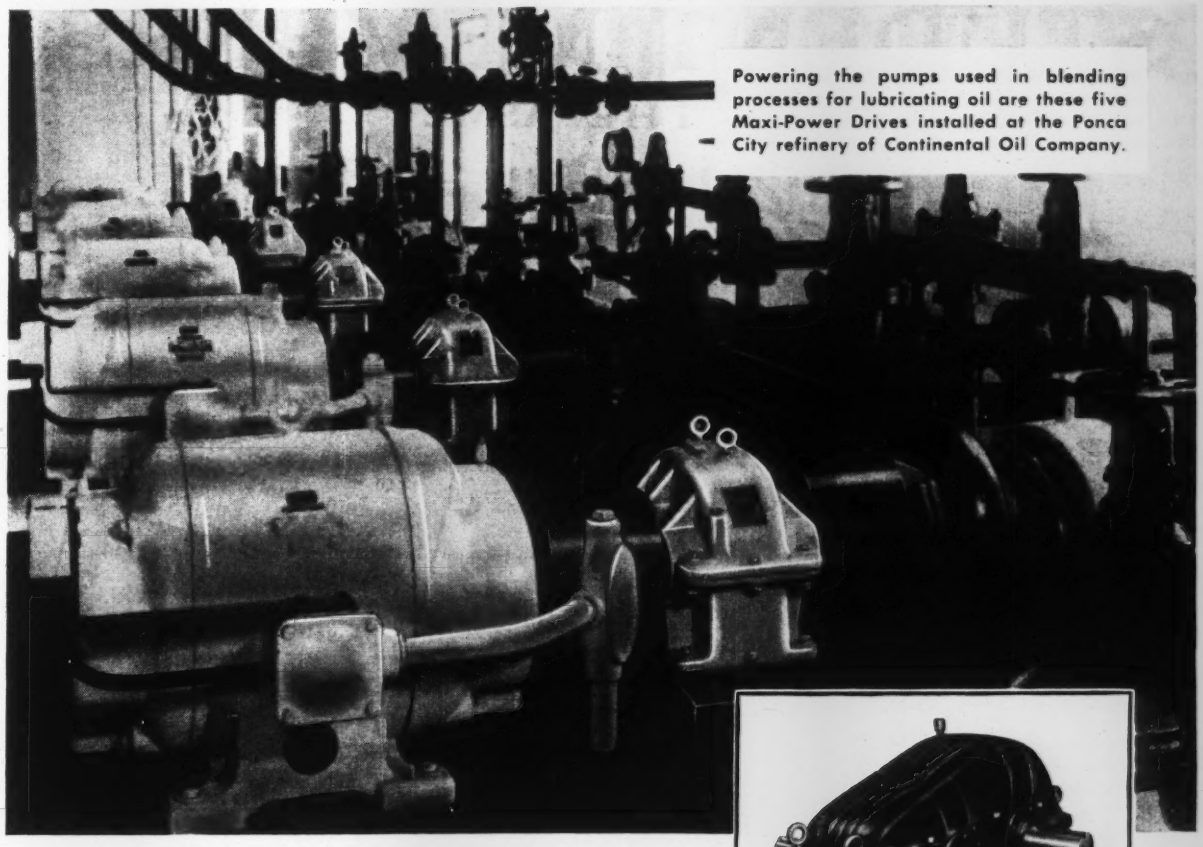
To vaporseal thermal insulation specify INSUL-MASTIC 4010. Our technical engineers are available to help you with this and other coating specifications.

Think first of the coatings that last!

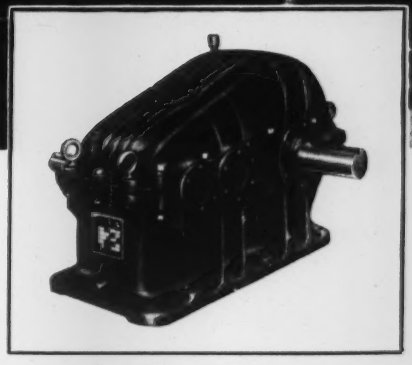
Insul-Mastic

CORPORATION OF AMERICA
Oliver Building • Pittsburgh 22, Pa.
Representatives in Principal Cities



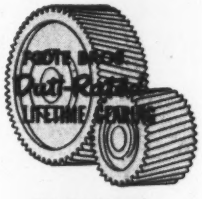


Powering the pumps used in blending processes for lubricating oil are these five Maxi-Power Drives installed at the Ponca City refinery of Continental Oil Company.



MAXI-POWER

They Thrive on Heavy Duty



This Trademark Stands for the Finest in Industrial Gearing

Any drive will do a good job the first day, but how will the record read after a month — a year — five years?

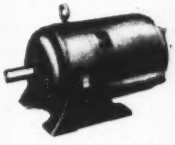
Will it — like Foote Bros. Maxi-Power Drives — still have the stamina to handle high horsepowers for hardest, day-after-day service? Will its maintenance costs remain low? Will efficiency still approach 100%?

And when you're deciding on a drive, is space a crucial factor? Maxi-Power's superior gearing is designed into the most compact housing to assure maximum load-carrying capacity in minimum space for heavy-duty units.

Sturdy — reliable — Maxi-Power Drives provide years of better performance for the most rugged applications. Available with single, double or triple reductions in sizes to meet your requirements. Ratios range up to 360 to 1, capacities up to 1,550 h.p.

Call your Foote Bros. representative, or write for detailed information.

Line-O-Power Drives



Foote Bros.-Louis Allis Gearmotors

Hygrade Drives

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. Q, 4545 South Western Boulevard, Chicago 9, Illinois

Please send Bulletin MPB containing full information about heavy-duty Maxi-Power Drives.

Name .....

Company .....

Address .....

City ..... Zone ..... State .....

STUDENT MEMBERS
OF THE ASME

you can get—

A LITTLE CASH!
A LITTLE FUN!
A LITTLE FAME!

HERE'S your opportunity to get that for which you have lacked the wherewithal. There's just one catch — you will have to work for it! If you quit easily — don't read any further. Perhaps a little extra work on your thesis will do the trick.

An engraved certificate signed by the President and Secretary of the Society will accompany each award.

A trip to the Annual Meeting as a guest of the "Old Guard" will be awarded.

Students should consult the Honorary Chairman regarding the rules for these awards. Only papers by single authors will be considered.

Each student must submit his paper to the Vice President of the Region in which his Student Branch is located not later than ***May 15, 1954.***

$150.00

For the best paper by an undergraduate on the subject "The Engineer in Business and Industry." This is the Charles T. Main Award.

An undergraduate must submit his paper for the Charles T. Main Award or Undergraduate Student Award before thirty days after the completion of his undergraduate work.

$25.00

For the best paper on an engineering subject by an undergraduate. This is the Undergraduate Student Award.

$25.00

For the best paper on an engineering subject by a graduate student. This is the Postgraduate Student Award.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th St., New York 18, N. Y.

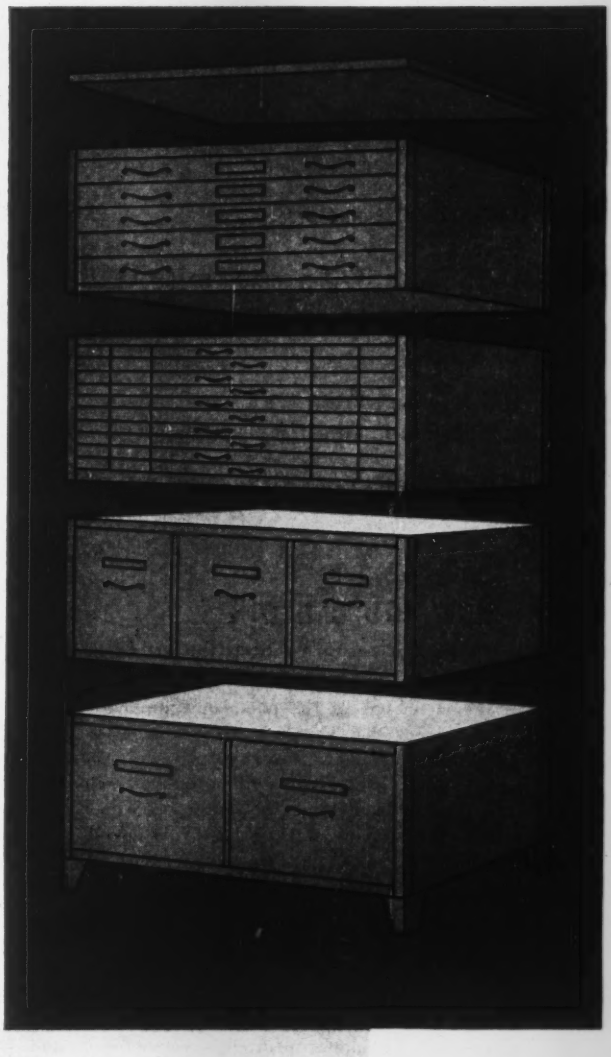
KEEP THOUSANDS OF TRACINGS SAFE

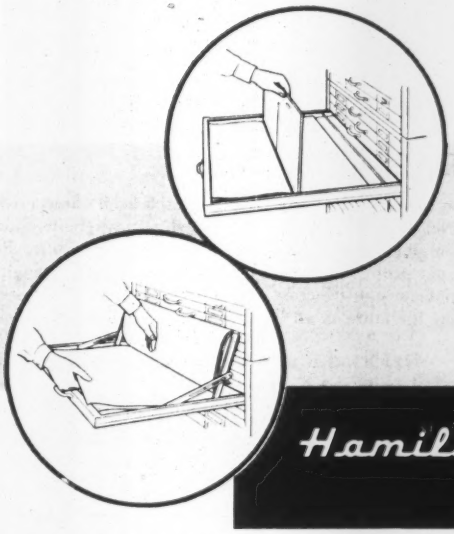
...find any *one* instantly!

in Hamilton's steel sectional UnitSystem

Hamilton's filing units provide *maximum capacity with absolute protection!* The 10-drawer Shallow Drawer Unit alone holds 1,000 drawings — kept flat, safe, readily accessible by exclusive *Tracing Lifters.* Available too are strong, commodious 5-drawer units with plastic-faced, canvas drawing protectors; and 2- and 3-drawer Vertical filing units.

Many units interlock in a single, compact UnitSystem installation. Such convenience and protection can save you thousands of dollars in irreplaceable work —and time. For details on *any* item produced by the world's largest manufacturer of drafting equipment, see your Hamilton dealer now!





Tracing Lifter holds sheets down firmly, smoothly. Front half raises to let sheets be folded over and back, until desired drawing is found and easily slipped out. Standard equipment in the 10-drawer unit.

Hamilton Manufacturing Company

Two Rivers, Wisconsin

There is Still Time to Win a Fine Camera

Enter the Peerless Photocopy-in-Industry Contest

Only One Month Left. Complete Set of Prizes Will be Awarded

1st PRIZE Your choice of:

Contessa 35 Tessar f/2.8, retail price $216.00
Ikoflex IIa Tessar f/3.5, retail price $216.00

2nd PRIZE Contina I Tessar f/2.8, retail price $119.00
Your choice of: Ikoflex Ia Novar f/3.5, retail price $125.00

3rd PRIZE Nettar IIc Novar f/6.3, retail price $41.70

1st Prize—Contessa 35
An outstanding 35 mm camera with 35 mm Zeiss Opton coated Tessar f/2.8 lens. Automatically focused by a built-in combined view- and range-finder. Has built-in photo-electric exposure meter. Synchro Compur shutter is fully synchronized. Speeds from 1 to 1/500 sec.

1st Prize—Ikoflex IIa
A truly fine reflex camera with Zeiss Opton coated Tessar f/3.5 lens, in Synchro Compur fully synchronized shutter. Speeds from 1 to 1/500 sec.

The cameras listed above will be sent to the winners of this contest at absolutely no cost. All cameras come complete with top-grain leather carrying cases. All carrying charges prepaid.

HERE'S HOW YOU CAN WIN

The contest is open to everyone actively interested in industrial photocopy.

Write a report on one of the photocopy applications or photocopy techniques that you find most valuable in your business. There is no limit to the length of your report. It can be supplemented with examples of the result achieved, sketches of the process, anything which you feel will lead to a full appreciation of your use of photocopy. Although originality is important, the significance of the result achieved will determine the winners.

Example: Suppose you use photocopy to eliminate certain drafting steps such as the redrawing of an entire part in order to make a simple change. Tell in your report exactly what steps you take to get the desired result. Tell also what this means to your drafting department in terms of time saved. Name the paper and machines involved in your process, and tell why you use them. Remember, the more complete and understandable your report, the better your chance to win.

ONLY ONE MONTH LEFT!

To qualify for this month's awards, entries must be postmarked no later than December 10, 1953.

THE JUDGES

The contest will be judged by the executive board of Industrial Photography magazine: Ben Zale, Editor; Lloyd E. Varden, Scientific-Technical Editor; David B. Eisendrath, Jr., Technical Editor. The winners will be reported shortly after the closing date.

YOUR REPORT IS A VALUABLE CONTRIBUTION TO THE INDUSTRY

We are planning to publish the winning reports as a portfolio of modern photocopy practices. The purpose of this portfolio will be to show how valuable photocopy is as an industrial tool, and as evidence of what is being done by experts in the field. No report will be published in the portfolio, or used in any other advertising or promotional material without your written permission and that of the company involved.

PEERLESS PRODUCTS

Peerless is one major manufacturer in the field whose production and development facilities are devoted exclusively to industrial, scientific and commercial photo-reproduction. The entire Peerless line of photocopy papers and machines is sold only through a network of factory distributors who are skilled photocopy specialists. Complete literature on all Peerless products is yours for the asking.

DON'T DELAY! Send your report to:

PEERLESS PHOTO PRODUCTS, INC.

Shoreham, Long Island, N.Y.

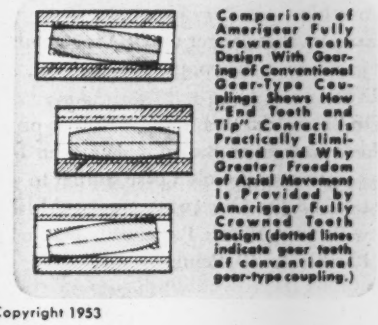
Manufacturers of Quality Photocopy Papers and Special-purpose Industrial Photocopy Equipment

THE Amerigear* FULLY CROWNED TOOTH DESIGN

practically eliminates "End Tooth and Tip" contact
. . . gives greater freedom of axial movement

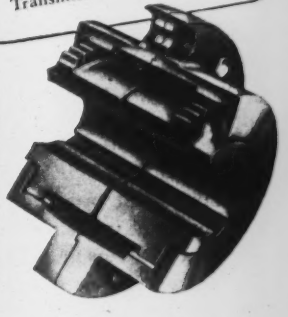
Crowned Tip Contacts Root of Internal Gear Tooth in Sleeve, Accurately Piloting Sleeve with a Ball and Socket Action.
Chamfered to Eliminate Interference with Sleeve Tooth Fillet and Allow Contact on True Flank of Gear Tooth.
Crowned Flank Carries All the Load and Provides for Correction of Lateral and Angular Misalignment Conditions.
A MAJOR IMPROVEMENT IN GEARING

Pat. & Pat. Pending



Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

Amerigear*
Fully Crowned Tooth Design Solves Wide Range of Power Transmission Problems.



Oil Seals of Amerigear Couplings Are As Advanced in Design, Performance, and Effectiveness As Is the Amerigear Fully Crowned Tooth.

This major improvement in gearing—a fundamental improvement in gear tooth design results in these advantages: (1) Relief from extraneous stresses; (2) Crowned flanks providing for angular and lateral misalignment with back lash reduced to a minimum; (3) Torque load carried on flanks of teeth rather than on tooth edges; (4) Greater loads and higher speeds with corresponding longer life for coupling and equipment; (5) Close fit on crowned tips and flanks of teeth, inducing a ball and socket action between hub teeth and internal sleeve teeth, assure quiet and smooth performance. These advantages distinguish the Amerigear Couplings from common gear-type couplings. If your problem arises from excessive offset or angular misalignment, tight back lash requirement, space limitations, high speeds and loads, or any combination of these, the best solution is assured by use of the Amerigear Couplings with the Fully Crowned Teeth. Amerigear Engineers are available for consultation.

*Trade Mark Reg.

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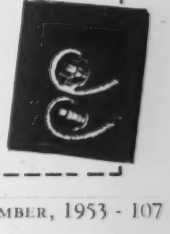
AMERICAN FLEXIBLE COUPLING COMPANY

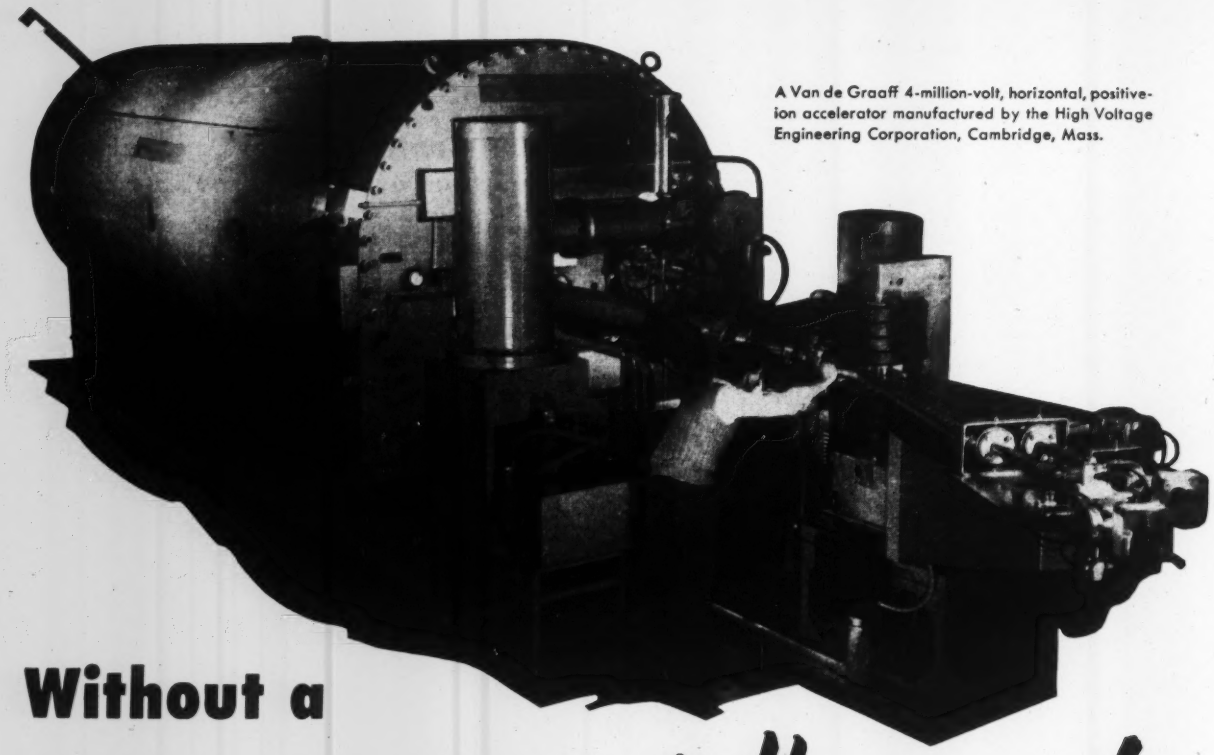
ERIE, PA., U. S. A. ***Originator of the Amerigear Fully Crowned Tooth***
Sales Offices in Principal Industrial Centers

In Canada: Canadian Zurn Engineering, Ltd. • 2052 St. Catherine St. W., Montreal 25, P. Q.

American Flexible Coupling Co., Erie, Pa., U. S. A.
Please send me further information regarding AMERIGEAR COUPLINGS with the Fully Crowned Teeth and Catalog No. 501.

Name ..... *Title* .....
Company .....
Address .....
City ..... *State* .....
Please attach to your business letterhead.





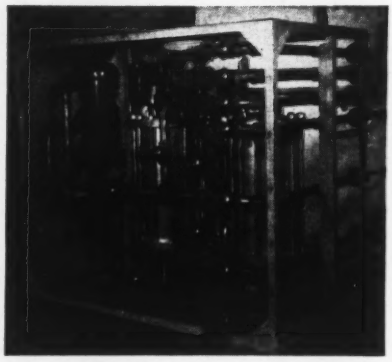
A Van de Graaff 4-million-volt, horizontal, positive-ion accelerator manufactured by the High Voltage Engineering Corporation, Cambridge, Mass.

Without a DRY gas insulation, *Whammo!*

A 4-million-volt streak of lightning would arc through normal humid air or gases, strike against the metal shell of this Van de Graaff electrostatic atom smasher and cause trouble.

A BAC-150 Lectrodryer* eliminates this danger by DRYing insulating nitrogen and carbon dioxide gases to a dewpoint of −100°F . . . or lower, and KEEPS THEM DRY!

Lectrodryers are providing DRYness like this to air, gases or organic liquids in many industries where unwanted moisture has been found troublesome. Perhaps in our files right now there's a case similar to yours which Lectrodryer has solved successfully. Our engineers would like to discuss any moisture problem with you. Write: Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.



Type BAC-150 Lectrodryer used by the High Voltage Engineering Corp. for DRYing insulating gases charged into high-voltage atom smashers.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

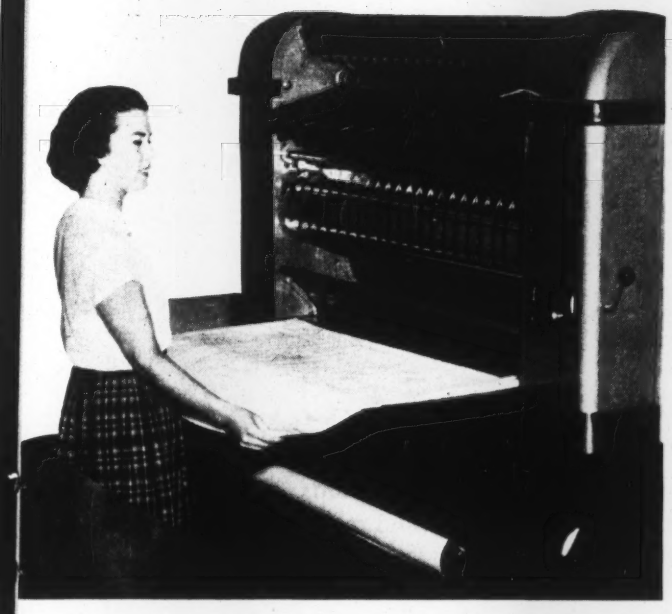
LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

Instead of starting all over again

...he begins here

Here's how the Lukens Steel Company, Coatesville, Pa., uses Kodagraph Autopositive Paper to eliminate retracing in preparing flow diagrams and piping layouts.



These diagrams and layouts must also show the floor plans and fixed equipment installations of the departments involved. But instead of retracing this information from the basic plant layout drawings, Lukens Steel simply reproduces the drawings on Kodagraph Autopositive Paper—gets *positive, photographic* duplicate tracings directly.

This gives the draftsman a tremendous head start . . . for he only has to add the new detail to the Autopositive print . . . *and another job is done instead of being barely begun.*

Low-cost Autopositive reproductions are made this easily at Lukens Steel:

Kodagraph Autopositive Paper is exposed with the drawings in a direct-process machine . . . and processed in standard photographic solutions. A fast, convenient room-light operation that produces positive photographic intermediates *without a negative step . . . without a darkroom.* These intermediates, in turn, assure highly legible prints.

Lukens Steel Company also uses Kodagraph Autopositive Paper *to produce print-making masters* from vendor blueprints; *to simplify filing*, by combining small vendor drawings on Autopositive intermediates in the standard Lukens drawing size; *to get low-cost protection* for original drawings which must be sent out of the plant.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction.

Get the full story on the sensational line of Kodagraph Materials which you, or your local blueprinter, can process easily, at low cost. Write today for a free copy of "Modern Drawing and Document Reproduction."

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16

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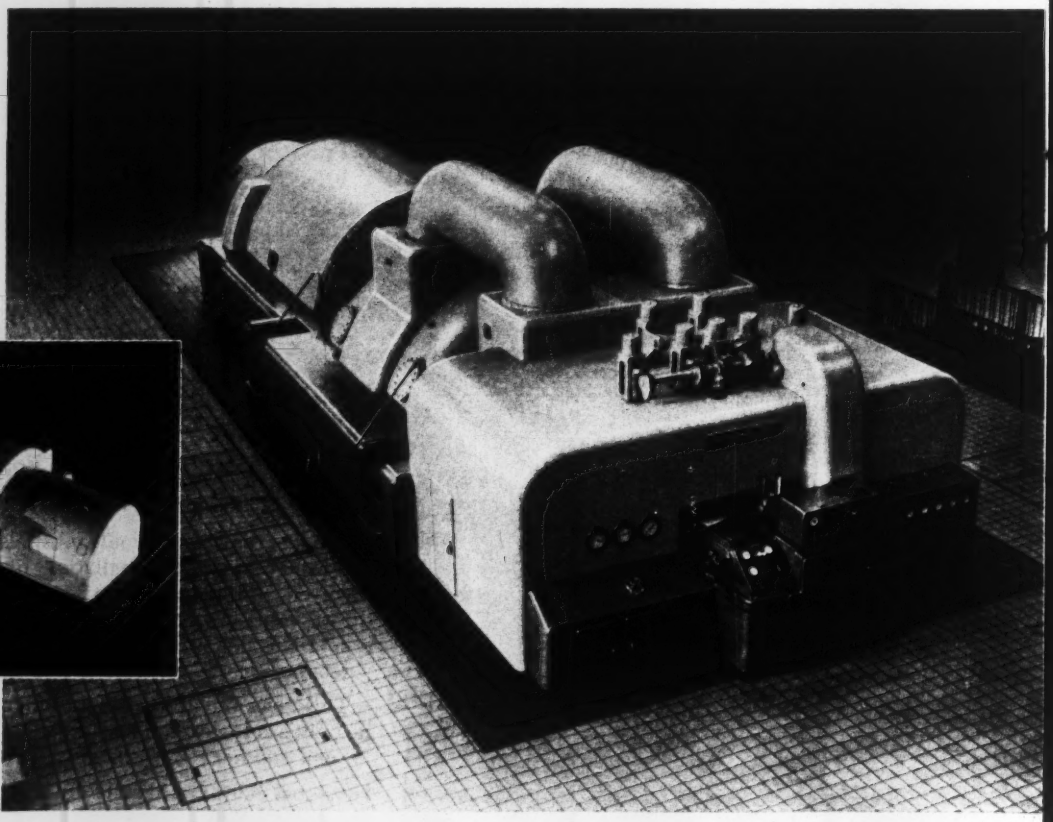
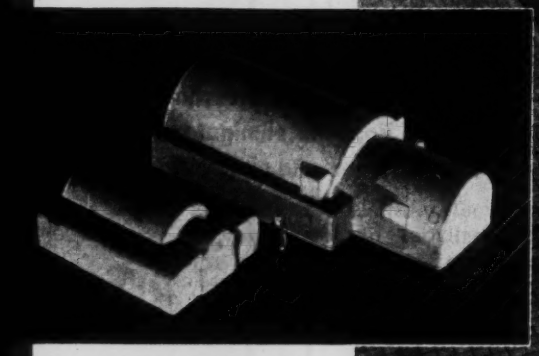
Kodak
TRADE-MARK

Major Developments



At right: World's first *supercharged* hydrogen-cooled turbine generator — with direct rotor conductor cooling — installed at the Wisconsin Power and Light Company's Edgewater Station in 1951.



Above: Relative size of fully *supercharged* and standard hydrogen-cooled generators of the same kw rating.

Operation-Proved Supercharged Generator

Availability — 100%. On-the-line service factor — 97.41%. That summarizes the performance of the world's first *supercharged* hydrogen-cooled turbine-generator unit during its first full calendar year of operation.

By cutting generator size, *supercharged* direct conductor cooling permits smaller plant size, less expensive foundations, and smaller breakers and bus structures; minimizes mechanical design limitations; raises possible maximum ratings, and reduces field assembly problems.

That these advantages are obtainable has been proved in operation.

As a result, Allis-Chalmers is now building a completely *supercharged* generator resulting in the size reduction shown in the small illustration at left above.

A-4089

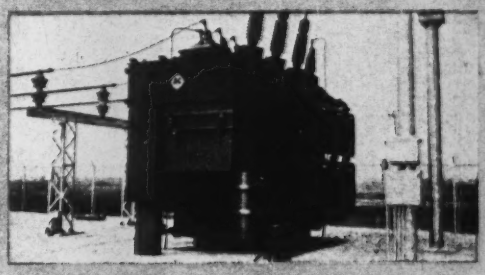
Equipment for Power: Water Conditioning equipment, chemicals and service . . . Steam and Hydraulic Turbines . . . Generators . . . Condensers . . . Steam Jet Air Ejectors . . . Power Plant Pumps and Motors . . . Transformers . . . Circuit Breakers . . . Switchboards and Control . . . Switchgear . . . Unit Substations . . . Utilization equipment.

ALLIS-

in Power Equipment

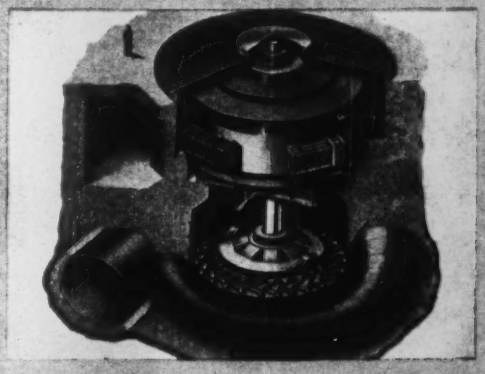
Corona-Free Power Transformers

Because Allis-Chalmers is building transformers rated 220,000 kva and others for 330,000-volt transmission, you can depend on A-C for units engineered to meet any application requirements. To check insulation aging, A-C transformers are designed to be corona-free even at highest test voltages. Without corona, transformers stay young, since repeated voltage stresses do not cause progressive deterioration of the insulation.



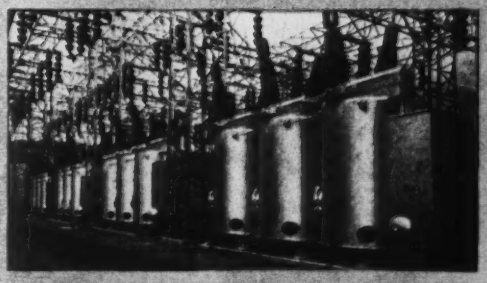
Reversible Pump-Turbine Units

Pioneered by Allis-Chalmers, reversible pump-turbines can solve some troublesome peak load problems. They do this by reducing the amount of equipment formerly needed for pumped storage operation; the single unit operates alternately as a turbine-generator and as a motor-driven pump. Five units are now in production, with turbine ratings ranging from 12,650 to 120,000 hp. The latter unit will combine the world's largest motor, with a rating of 102,000 hp, and the largest Francis turbine ever built.



High Speed Circuit Breakers

As power systems grow, A-C circuit breakers keep pace with the new demands for size, speed and reliability. Mechanically trip-free pneumatic operators, originated by A-C in 1937, are in service on 20-20-20 cycle repetitive reclosing 3-cycle breakers. Now, hydraulic accumulator principles have been combined with proven pneumatic operation to produce the *Pneu-Draulic* operator and set new standards for large power circuit breaker speed and reliability.



Multi-Steam-Path Condensers

Allis-Chalmers is supplying six 100,000 sq ft surface condensers for the 2,200,000 kw of added private utility capacity being provided for AEC's Ohio diffusion plant. A-C multi-steam-path condensers have consistently helped to cut power costs. With 60 years of experience building over 13,000,000 sq ft of condenser capacity, A-C has the proven engineering and manufacturing facilities to build the largest condensers that might be required.

Pneu-Draulic is an Allis-Chalmers trademark.

CHALMERS

A-C ALLIS CHALMERS

For more information, contact your nearby A-C representative, or write Allis-Chalmers, Milwaukee 1, Wis.

Combined trip-throttle valve permits operator to throttle steam directly into G-E Type DP Mechanical-Drive Turbine, usually eliminating need for extra valve in steam line.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Combined Trip-throttle Valve Cuts Turbine Installation Costs

To save you the cost both of buying and installing a throttle valve in the steam line, General Electric designed into its standard Type DP mechanical-drive turbine a trip valve which also functions as a throttle valve. This feature alone can save you up to $200.00 at time of installation.

The combined trip-throttle valve controls steam admission to the turbine on starting and also shuts off all steam in case of overspeed. No need in most cases to shut off steam valves ahead of the turbine before restarting the unit. The combined trip-throttle valve can quickly be reset and the turbine put back on the line, saving you time in an emergency.

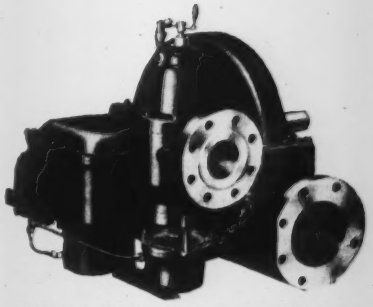
THIS COMBINED TRIP-THROTTLE VALVE is just one of many DP features which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features to save you extra costs. For more information contact your nearest G-E apparatus sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 252-63

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



G-E Type DP Mechanical-Drive Turbine

COMPARE THE FEATURES
EVALUATE ALL THE COSTS

See why G-E standard Type DP turbines are your most economical buy.

You're looking at the biggest pressure gauge development since the "Recalibrator"

Here is one of those typically MARSH developments . . . the kind of pioneering step you have come to expect from the organization that originated the basic advances in pressure gauges culminating in the exclusive "Recalibrator." This latest Marsh development is known as the

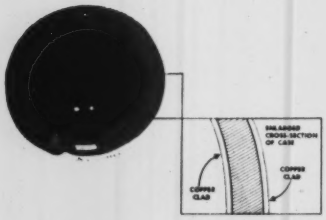
NEW MARSH *"Conoweld"* TUBE

This time we have made the best part of the best Marsh gauge still better. We have gone into the part that actually does the work — the socket and tube — and have made it permanently leak-tight from inlet to tip of tube.

We have done this by fusing the tube into the socket and the tip to the tube so that the whole assembly is truly *one piece.* The photo of one of the sockets sawed in half shows the perfect fusion of the vital joint. Tests and photomicrographs prove the perfection of the fusion.

Developing the fusing process called for extensive research. The method as finally perfected — the "Conoweld" process — involves first fusing the tube to the socket and end-piece; then tempering the tube to required resiliency.

Yes, it is these dramatic departures from beaten paths that have achieved leadership for Marsh gauges and are ever increasing that leadership. Ask for latest information covering gauges for all services.



Another first for Marsh

Here is a case in keeping with the "Conoweld" tube. Another recent Marsh development, it is called the

New *Marshalloy* Case

It is a copper-clad wrought steel case of boiler plate thickness, four times as strong, and one-third lighter than conventional cast iron cases. Copper surface makes it as non-corrosive as a plastic or die-cast case. Handsome, corrosion-resistant, satin black enamel and Marsh safety blow-out plug are the finishing touches.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*

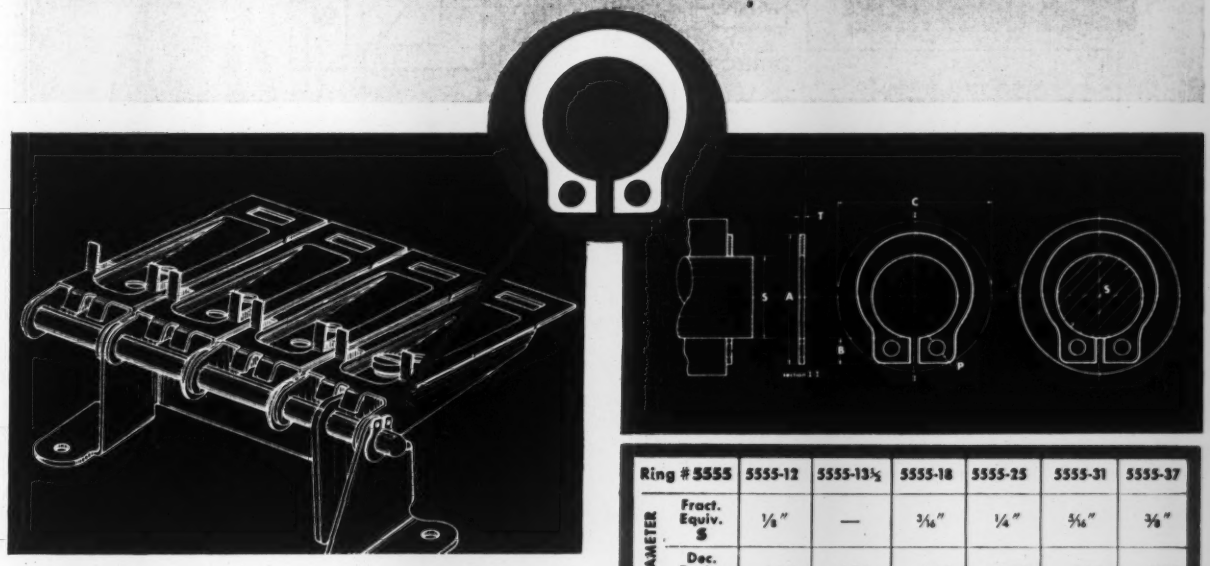
Dept. 29, Skokie, Ill. *Export Dept. 3501 Howard St., Skokie, Ill.*

MARSH GAUGES

"THE STANDARD OF ACCURACY"

MANUFACTURERS OF THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES • HEATING SPECIALTIES

New Waldes Truarc GRIP Ring requires no groove, holds fast by friction, can be used over and over again



Ring #5555		5555-12	5555-13½	5555-18	5555-25	5555-31	5555-37
SHAFT DIAMETER	Fract. Equiv. S	1/8"	—	3/16"	1/4"	5/16"	3/8"
	Dec. Equiv. S	.125	.136	.187	.250	.312	.375
	TOL.	±.002	±.002	±.002	±.002	±.003	±.003
RING DIMENSIONS	Thickness T	.025	.025	.035	.035	.042	.042
	TOL.	±.0015	±.0015	±.002	±.002	±.002	±.002
	Length A	.268	.285	.364	.437	.553	.626
	Lug B	.078	.078	.097	.097	.141	.141
	Hole P	.042	.042	.042	.042	.078	.078
	Min. Ring Clear C	.33	.34	.44	.50	.67	.73
Approx. Ultim. Thrust Load (Lbs)		20	20	25	35	50	60

The Waldes Truarc Grip Ring is a new, low cost fastener that provides a positioning shoulder secure against moderate thrusts or vibration. Installed on a straight ungrooved shaft, the Truarc Grip Ring can be assembled and disassembled in either direction with Truarc pliers.

The Grip Ring can be installed tightly against a machine part in order to take up end-play. The basic Truarc design principle assuring complete circularity around periphery of the shaft and the ring's unusually large radial width combine to exert considerable frictional hold against axial displacement. The ring can be used again and again.

Find out what Waldes Truarc Retaining Rings can do for you. Send us your drawings. Waldes Truarc engineers will give your problems individual attention without obligation.

SEND FOR NEW CATALOG ➧

WALDES

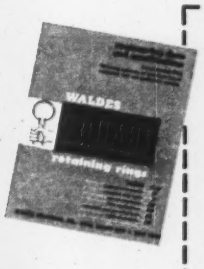
TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,185; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING



Waldes Kohinoor, Inc.,
47-16 Austel Place, L.I.C. 1, N. Y.

ME 115

☐ Please send me sample Grip-Rings (please specify shaft size _____)

☐ Please send me the complete Waldes Truarc catalog.

(PLEASE PRINT)

Name _____

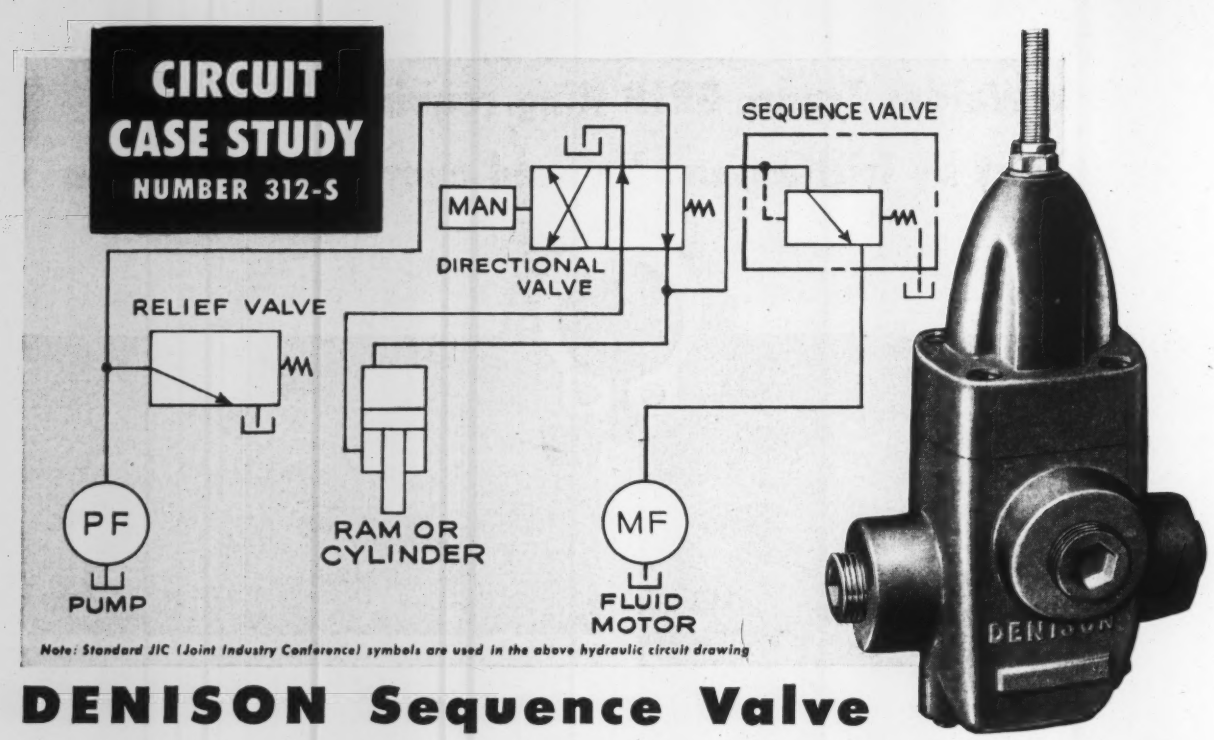
Title _____

Company _____

Business Address _____

City _____ Zone ____ State _____

CIRCUIT CASE STUDY
NUMBER 312-S



Note: Standard JIC (Joint Industry Conference) symbols are used in the above hydraulic circuit drawing

DENISON Sequence Valve

controls oil flow to secondary circuit with *quick, direct action*

Above, you see a typical circuit utilizing a Denison **Sequence Valve** of the direct-operating type. Here, oil pressure is developed by a fixed-displacement pump. When the manual control of the directional valve is held open, pressure is directed to a cylinder, which performs the primary operation. As the piston rod of the cylinder meets resistance, pressure increases. When the increasing pressure equals pressure setting of the **sequence valve** (which is easily adjusted to any operating need) it acts upon a small pilot piston in the **sequence valve**, shifting the valve spool. Oil flow is now open to both the cylinder and to secondary operation, performed in this case by a fluid motor. Additional sequence operations could be provided in similar manner.

Pressure build-up at the primary operation brings quick action on the spool of the **sequence valve.** The pilot piston, which eliminates the need for heavy spring loading of the valve spool in circuits operating at pressures above 250 psi, is not employed in models designed for lower pressures. Instead, pressure acts directly against the valve spool, assuring high sensitivity to low-pressure changes. These **sequence valves** are externally drained.

Denison direct-operating **sequence valves** provide positive action at relatively low cost, for circuit pressures from 25 to 2000 psi, and are readily adaptable to remote control arrangements. Denison also makes hydrostatically-operated **sequence valves** for pressures to 5000 psi.

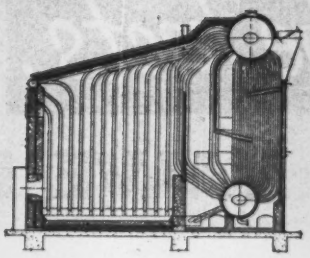
Denison direct-operating pressure control valves are available in a wide range of models, for relief, unloading, counterbalance and sequence needs —with or without remote control and built-in checks. All are available in ½, ¾, 1¼, 1½ inch sizes, for all pressures to 2000 psi. Choice of threaded, subplate, or flange connections. We invite your inquiry on circuit needs of this type — or write for bulletin VRD.

Denison offers one of the most widely practical lines of oil hydraulic pumps, motors and controls for circuits operating at pressures up to 5000 psi. Designed and built with skill and knowledge gained through twenty-five years of engineering leadership in oil hydraulics, they offer the compact ruggedness needed for exacting, heavy-duty demands. Wherever you need closely adjustable power and control with unlimited flexibility of application, specify Denison HydrOILic Equipment. Your request for information will not obligate you in any way.

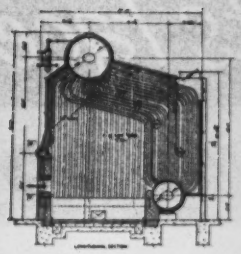
DENISON HydrOILics

"The Finest Money Can Buy!" in Pumps, Motors and Controls

The DENISON Engineering Company, 1189 Dublin Road, Columbus 16, Ohio



2 Drum Water Tube Boiler



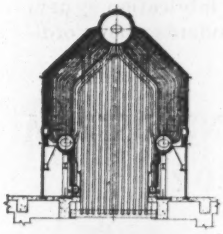
Type-S 2 Drum Boiler Series S1

FOR ALL INDUSTRY . . .

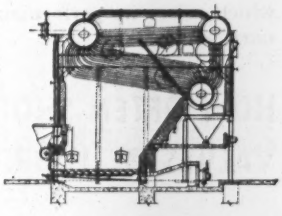
WICKES

STEAM GENERATORS

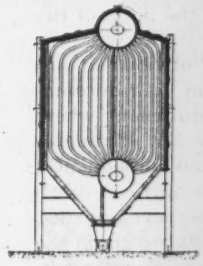
• In the oil, paper and chemical industries and in manufacturing plants, institutions and public buildings throughout the world Wickes Steam Generators are in constant daily service. All types, such as those illustrated on this page, with capacities up to 250,000 lbs. steam per hour and 1000 psi. Write for descriptive literature.



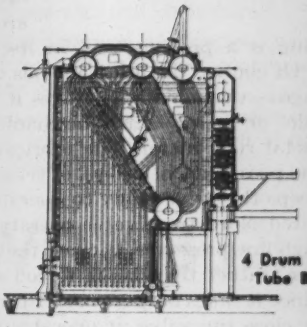
"A" Type Water Tube Boiler



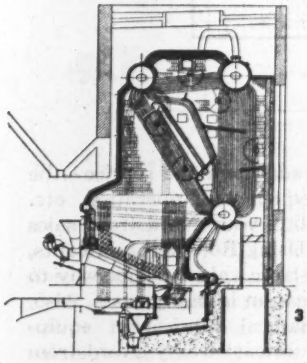
3 Drum Low Head Water Tube Boiler



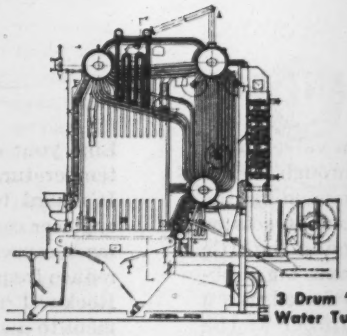
Wickes 2 Drum Waste Heat Installation



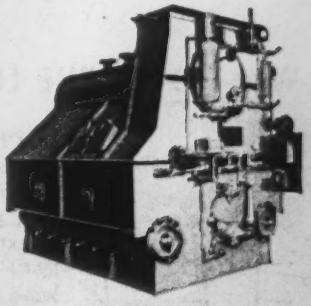
4 Drum Water Tube Boiler



3 Drum Water Tube Boiler



3 Drum "B" Type Water Tube Boiler



Type "A" "Packaged" Steam Generator

THE WICKES BOILER COMPANY • DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

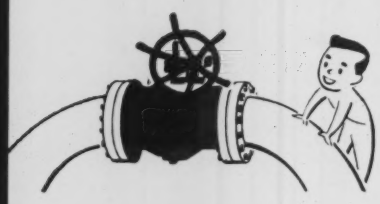
Let's Face the Facts . . .

DOES VALVE LUBRICATION

Now and then someone revives an old argument—"it costs too much to maintain lubricated valves."

On the surface, that sounds logical. But if that really was a fact, millions of Nordstrom lubricated valves in service today could never have been sold.*

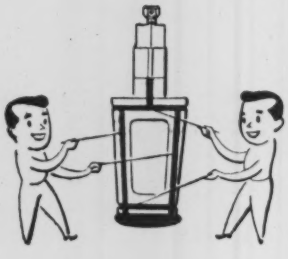
WHAT IS THE ADVANTAGE OF A LUBRICATED VALVE?



The most important function of lubricant in a Nordstrom valve is to give a tighter seal than can be accomplished through any other method yet developed. The thin film of plastic lubricant that is forced around the ports of the plug is a pressure seal in itself.

Of course, the lubricant has other obvious advantages—the same advantages it has in your automobile, or in any other mechanical equipment where metal rubs metal. The lubricant all but eliminates the possibility of galling or seizing, and consequently keeps the valve ready to operate in a hurry. A lubricated Nordstrom valve operates easily even against high line pressures, because the plug turns *within* the line, rather than being forced or wedged *against* it. Since it takes only a quarter turn of the plug to open or close the valve, it operates in seconds instead of minutes.

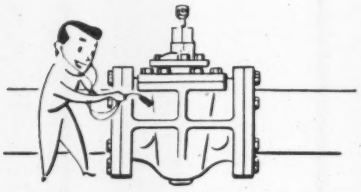
WHAT DOES THE LUBRICANT DO?



In a Nordstrom valve, lubricant is forced through a series of grooves surrounding the plug ports. There it acts as an extra seal against the little leaks that become big problems. It is also forced into a lubricant chamber at the small end of the plug where it serves as a hydraulic jack to keep the plug easy to turn.

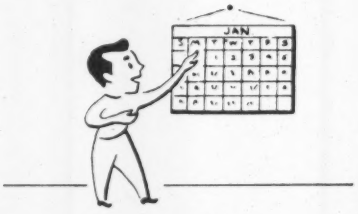
Finally, it *lubricates* . . that is, it prevents grinding wear, fills tiny imperfections that may develop, and it lets the plug slide without grating.

WILL A NORDSTROM VALVE WORK WITHOUT LUBRICANT?



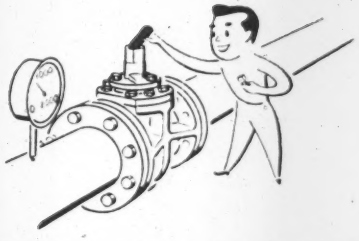
Yes, but then the whole advantage of a lubricated valve is lost. Your car will also operate without lubricant, but with proper lubricant, it is far more efficient, lasts many, many times longer, needs much less maintenance, and is safer. So is a valve. Nordstrom is fundamentally a valve—a plug valve made to exceptional standards of tolerance and quality—but it is the internal Nordstrom lubrication system which raises its performance standards above ordinary valves.

HOW OFTEN SHOULD NORDSTROM VALVES BE LUBRICATED?



Like your car, that depends upon the service—the temperature, process, frequency of operation, etc. It's hard to generalize, but your Nordstrom sales engineer can advise you. Using Rockwell lubricants, made especially for Nordstrom valves, is one way to reduce frequency of lubrication in many cases. Also, Rockwell markets mechanical lubrication equipment to make scheduled lubrication easy. Nordstrom Hypreseal valves are now built with an external fitting so that it is unnecessary to remove any parts from the valve before lubrication.

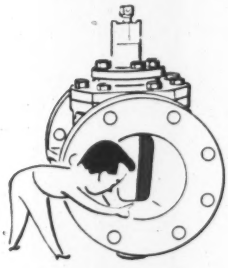
COST MONEY OR SAVE MONEY?



WHAT LUBRICANTS SHOULD BE USED?

Part of the effect of lubricating your car is lost if you use improper lubricants. That is also true of lubricated valves. Genuine Rockwell lubricants will save you money—they are the result of the longest and most extensive research into valve lubricants by any company. They are the result of years of field experience with nearly every process condition. For many services there are variations of Rockwell lubricants compounded to offset specific line conditions. Also, for many services Rockwell Hypermatic lubricant may be recommended. This lubricant, which is compressible and energizable, regenerates itself in the lubrication system, greatly reducing lubrication frequency. In any case, consult your Nordstrom sales engineer.

HOW LONG WILL PROPERLY LUBRICATED NORDSTROM VALVES LAST?



That's impossible to answer, since many of the first Nordstrom valves put into regular service are still going strong. The service has a lot to do with it, naturally. In gas service, there are many valves with more than 30 years service. In the valve-killing application of drilling rig mudlines, Nordstrom valves have been disassembled for inspection after more than 150,000 feet of hole on many occasions, found to be without wear, and returned for more service—often four times the life of ordinary valves. In a two-year paint plant test, Nordstrom valves were the only ones that did not need to be replaced because of leakage. Nordstrom files are full of such authentic field case histories—ask your Nordstrom sales engineer.

WHAT ABOUT MAINTENANCE COSTS FOR NON-LUBRICATED VALVES?

In any but the most simple services, any kind of valves need *some* maintenance. But in the case of Nordstrom valves, maintenance is generally confined to adding lubricant at intervals. Over a 20-year period, Nordstrom sales of repair parts have been less than half of one per cent of sales. In several plants in which records were kept and where Nordstrom and other valves were used, repair parts for Nordstrom valves ran about one-tenth of other makes.

The analogy to your car carries over here—if you don't lubricate it, you save on lubricant, but pay the far, far higher costs of part replacement. And more particularly, you'll need a new car much more often.

When you consider valve maintenance, be sure to count *all* the costs—not just simple service, but major repairs and complete replacement costs, shutdowns, extra labor to operate, and *all* factors.

If you do, if yours is a typical application, you'll find that year-in and year-out, the most economical valves you can use are Nordstroms.

If you'd like to discuss the suitability of Nordstrom valves for any service, let us know. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

* Nordstrom invented lubricated valves more than 30 years ago. Since that time, several million have been installed in hundreds of widely varied petroleum, gas, chemical and other process services. With by far the most complete range of sizes and pressures, and many patents on construction details, Nordstrom is the leader in lubricated valves.

PRESENTING THE NEW DRAVO *Paraflo* SPACE HEATER

Now available in units of 200,000 or 250,000 Btu/hr output

The new Dravo *Paraflo* Space Heater is designed for heating open areas in small commercial and industrial buildings. Typical installations include service stations and garages, construction offices, warehouses, recreation centers, agricultural buildings, stores, offices and showrooms.

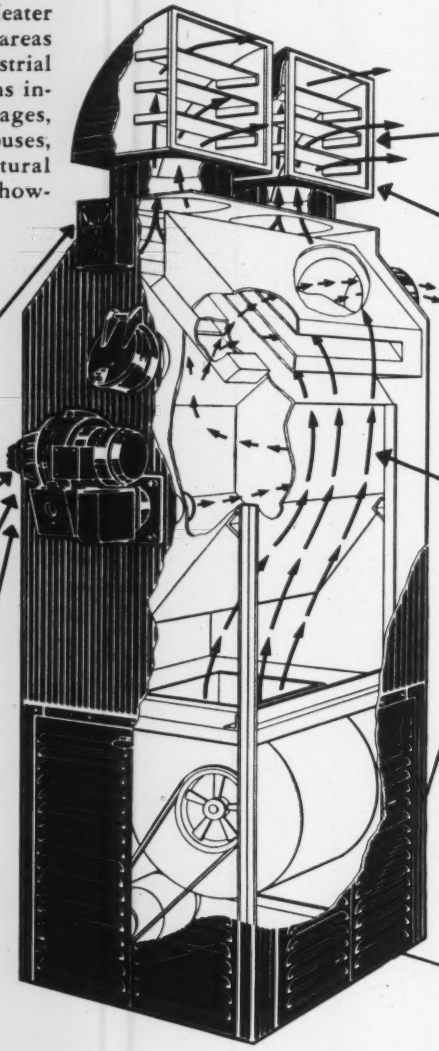
Look at these features

COMPLETELY AUTOMATICALLY AND THERMOSTATICALLY CONTROLLED— NO ATTENDANT REQUIRED

AUTOMATIC CONTROLS COMPLETELY WIRED AND FLAME-TESTED

GUN-TYPE OIL BURNER APPROVED BY UNDERWRITERS' LABORATORIES

BURNS UP TO AND INCLUDING NUMBER 2 OIL



MAXIMUM AIR THROW 90-FOOT. WITH OR WITHOUT DUCTWORK

DISCHARGE NOZZLES CAN ROTATE 360°

FLOATING STAINLESS-STEEL COMBUSTION CHAMBER ELIMINATES REFRACTORY LINING; GIVES LONGER SERVICE

The new Dravo *Paraflo* Heater makes available to you a complete line of oil-burning Dravo Space Heaters ranging from 200,000 to 2,000,000 Btu/hr output in the *Paraflo* or *Counterflo* series. Dravo also produces gas-fired space heaters in a range of 68,000 to 2,000,000 Btu/hr output in the Unit Heater and *Counterflo* models.

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Dravo Building, Fifth and Liberty Avenues
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Please send me complete information about the Dravo:
☐ *Paraflo* Space Heaters ☐ Gas-Fired Unit Heaters
☐ *Counterflo* Heaters

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Once more the ANY-SPEED Oilgear Drive betters machine performance "painlessly"

Many times in our experience the performance of an already highly efficient machine has been bettered without redesign, solely by changing the drive. One case out of many *varied* cases, is the Tolhurst Centrifugal pictured above, located in a great pharmaceutical house. This centrifugal was originally equipped with a two-speed electric motor drive. However the chemicals it is called upon to handle have widely varying crystal packing characteristics. Some of these crystals packed so densely at the speed available, extraction was inhibited, extraction time far out of balance and crystal removal difficult.

A change was made to an *"ANY-SPEED"* Oilgear Fluid Power Drive. Now the operator is able to shade the speed of the centrifuge experimentally—*and easily discover* the *best* speed for each batch of crystals.

As a result, extracting that used to take from 6 to 9 hours was cut to 4 to 6 hours. The extremely slow speed also available made unloading a great deal easier. This user now has several other Oilgear drives including one on a laboratory centrifuge.

There is very often a direct efficiency coefficient between machine operating speed and the type of work being handled. And we can cite many widely varying instances where equally dramatic and profitable gains resulted at once from a simple change to *"ANY-SPEED"* Oilgear Fluid Power Drives. If you want some interesting factual data on Oilgear's steplessly variable speed drives, their outstanding responsiveness to control impulses, their smooth acceleration and deceleration, talk to an Oilgear Engineering Representative. His mature and sound engineering recommendations may profit you greatly. THE OILGEAR COMPANY, 1570 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

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make ERIE Double-Action Hand-Pumps a BETTER BUY!

PULL-PUSH! Only 2 inch piston travel and the new Erie double action piston type hand pump delivers up to 23 gallons per 100 short easy strokes. It's non corrosive inside and out, for the body is aluminum die castings by Parker. Die Castings were selected because machining costs were virtually eliminated . . . and die castings are lightweight and strong. Parker Die Castings are used profitably in nearly every industry. They are produced of exactly the right alloy to rigid specifications. Consult with Parker on your next die casting requirements. Take advantage of Parker's experience in producing highest quality die castings.

PARKER WHITE METAL COMPANY • 2153 McKinley Ave., Erie, Pa.

and when you think of Die Castings THINK OF

PARKER ALUMINUM and ZINC Die Castings

window shopping costs nothing...
can save you plenty

It pays to "shop around" before you make your power transmission or conveyor chain selections. Because, in order to get the most for your money, you need the right chain for your designs. For example, a precision-finished roller chain is ideal for high speed drives. But, roller chain is not the economical, efficient choice for slow speed, heavy-duty service. A heavy-duty steel or cast chain may be your answer here. That's why it will pay you to "shop" through the *complete* Chain Belt line before you make your choice. There's a size and type to fit any power transmission or conveyor need.

Don't be handicapped by relying on a supplier with a limited line to answer all your needs. It may cost you more... may handicap the expected performance of your machines.

Your Chain Belt Field Sales engineer will be happy to assist you in making the exact chain selection that best fits your requirements. He is not prejudiced by the limitations inherent in an incomplete chain line... can recommend the chain that will give you the service you want... at the lowest possible cost. For complete information or engineering assistance, mail the coupon.

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Please send me information on Rex and Baldwin-Rex chains
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City.....*State*.....

Out of the Dark, a Red Grenade

IT WAS AN APRIL NIGHT and the Marines, near Panmunjom, were under heavy attack. In one of E Company's machine gun emplacements, Corporal Duane Dewey and his assistant gunner lay on the ground, wounded. A Navy Medical corpsman was giving them aid.

Out of the darkness, and into the group, lobbed a live Red grenade. Although he was already seriously wounded, and in intense pain, Corporal Dewey pulled the aid man to the ground, shouted a warning to the other Marine and threw himself over the missile.

"I've got it in my hip pocket, Doc!" he yelled. Then it exploded. By smothering the blast with his own body, Corporal Dewey had saved his comrades' lives.

"Now that I'm back in civilian life," says Corporal Dewey, "I sometimes hear people talk as though stopping Communism is a job only for our armed forces and the government. Believe me, it's a job for you and me, too. And one way we can both do that job is to make our country stronger by *making our own families more secure*—through saving and investing in United States Defense Bonds. Bonds are real protection—for my money!"

★ ★ ★

Now E Bonds pay 3%! Now, improved Series E Bonds start paying interest after 6 months. And average 3% interest, compounded semiannually when held to maturity. Also, all *maturing* E Bonds automatically *go on* earning—at the new rate—for 10 *more* years. Today, start investing in U. S. Series E Defense Bonds through the Payroll Savings Plan; you can sign up to save as little as $2.00 a payday if you wish.

Corporal
Duane Edgar Dewey, USMCR
Medal of Honor

Peace is for the strong! For peace *and prosperity* save with U.S. Defense Bonds!

The U. S. Government does not pay for this advertisement. It is donated by this publication in cooperation with the Advertising Council and the Magazine Publishers of America.

Power for the press

Link-Belt silent chains drive the majority of the nation's high-production newspaper presses

When it's time for your daily newspaper to "hit the street," it's there on schedule . . . day in, day out. To keep the huge presses rolling at high speeds—in precise register, with no interruptions of the run—requires positive, unfailing power transmission. That's why Link-Belt Silverstreak Silent Chain Drives are widely used—not only on printing presses—but wherever industry requires high-speed, dependable power transmission.

How do Link-Belt products touch your daily life?

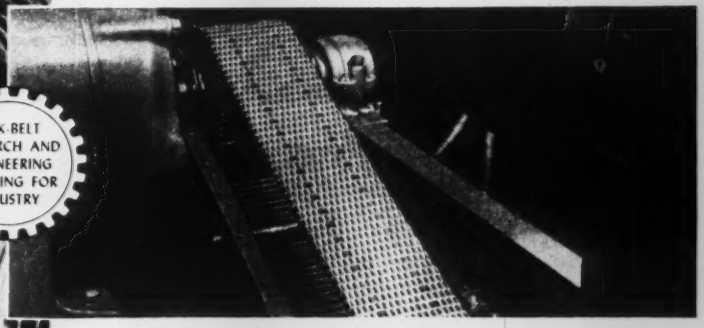
As a consumer, chances are the bed you sleep in, the food you eat, the clothing you wear was produced with the help of Link-Belt equipment. If you're a manufacturer, Link-Belt conveying, processing and power transmission machinery offers you top efficiency for every step of your operation. Yes, if you have a problem involving the movement of materials or the transmission of power, it will pay you to call Link-Belt. There's a Link-Belt plant, sales office, factory branch store or distributor near you. Call them for your power transmission and conveying needs.

LINK-BELT

One source . . . one responsibility for conveying and power transmission machinery

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Sydney; South Africa, Springs. Representatives Throughout the World.

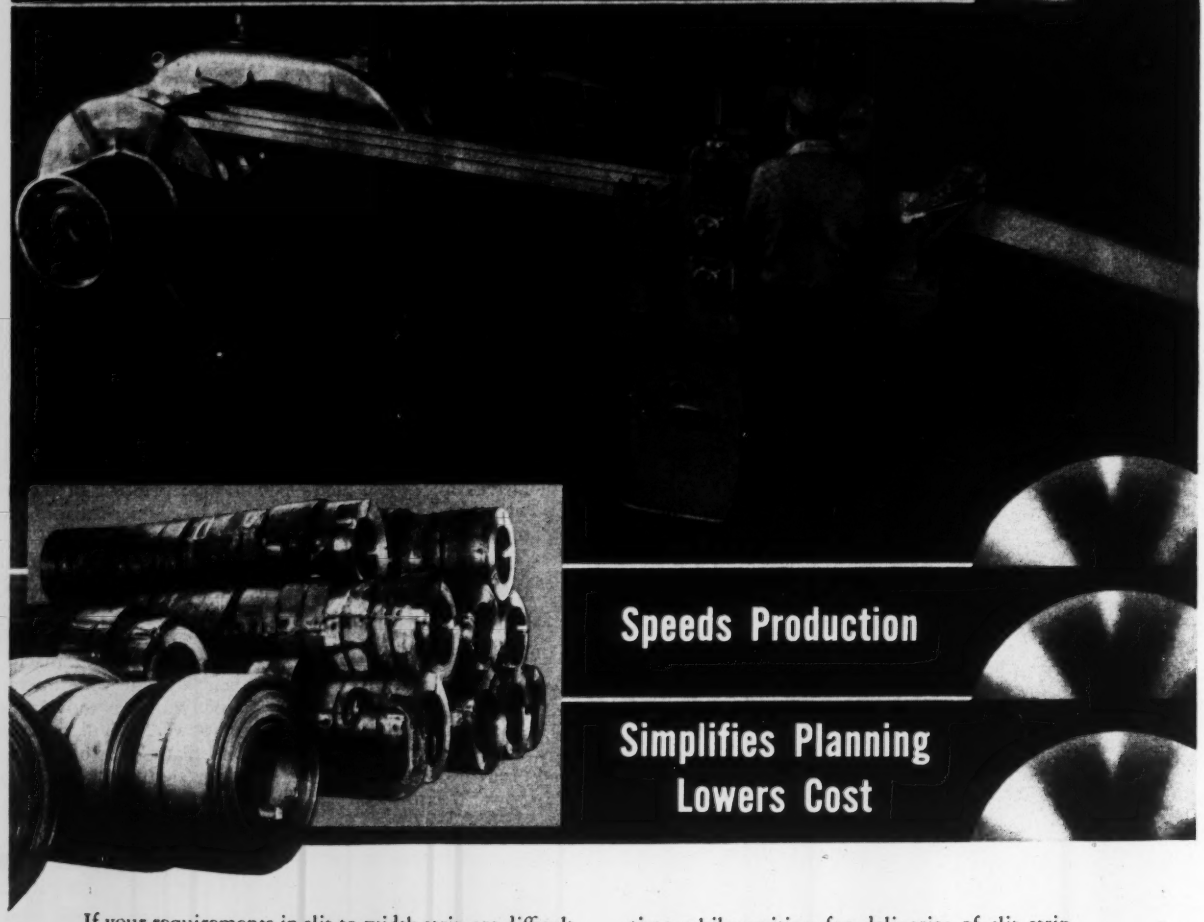
13,355



LINK-BELT RESEARCH AND ENGINEERING WORKING FOR INDUSTRY

At speeds up to 5000 feet per minute, Link-Belt Silent Chain transmits power to printing press drive shafts. Better than 98% efficiency is maintained throughout the chain's long life. Stocks of silent, roller and other types of chain are immediately available from your nearby Link-Belt factory branch store or distributor.

Double-Quick Slitting Service



Speeds Production

Simplifies Planning
Lowers Cost

If your requirements in slit-to-width strip are difficult to anticipate weeks or months in advance; if deliveries are slow and uncertain; if sources of slit strip supply are limited—a Yoder slitter may be the perfect answer to all these handicaps.

Aside from the great CONVENIENCE of being able to supply, on a few hours notice, your own needs in slit-to-width strip, from a relative small stock of standard-width coils, the *economies* effected are surprisingly great: First, by a substantial reduction in the price per ton; secondly, by elimination of idle time while waiting for deliveries of slit strip.

Your tonnage requirements, therefore, *need be no more than 100 tons per month (for narrow strands, much less) in order to make the slitter an exceedingly profitable investment.*

Yoder slitters and accessories are made in all sizes and types, for sheets as well as coils, small and large; narrow as well as wide strands; all gauges.

The Yoder Slitter Book is a practical treatise on the economics and mechanics of slitter operation. Send for it.

THE YODER COMPANY • 5499 Walworth Avenue, Cleveland 2, Ohio

Complete Production Lines

- ★ **COLD-ROLL-FORMING and auxiliary machinery**
- ★ **GANG SLITTING LINES for Coils and Sheets**
- ★ **PIPE and TUBE MILLS—cold forming and welding**

ENGINEERING YODER MANUFACTURING

Another specific reason why it's Kellogg . . . when reheat is the order!

OCCASIONALLY there arises a unique situation which specifically demonstrates why Kellogg has been selected so frequently to fabricate and erect the power piping for high temperature reheat units during the current power expansion period.

This one occurred during the installation of the piping for the Albany station of the Niagara Mohawk Power Corporation. In connection with improving the economics of the overall system, which includes the reheat cycle, Niagara Mohawk engineers developed a considerably simplified piping arrangement between the high pressure extraction heaters . . . one which eliminated customary expansion loops.

However, although this design had economic advantages, it posed a problem: Because of the absence of expansion loops, how severely would thermal expansion during the high heat of welding and heat treatment strain the flanges and bolts on the heaters? Excessive stresses on these joints might well cause leaks in service.

Since it is virtually impossible to calculate these forces with any accuracy, Kellogg called upon its stress analysis group to devise a procedure for controlling them. This was accomplished by the use of electrical strain gages mounted on supporting rods and on the heater shell as shown in the photograph. (See arrows)

As a result of readings taken throughout the cycle, standards were established for the field assembly of this design which assure protection of the flanged joints of these heaters

Special groups which specialize in stress analysis with its required knowledge of mechanics of materials—of plastic and elastic theory . . . continuous research and development towards further improvements in materials and in fabricating and erecting techniques . . . continuous accumulation of a tremendous store of experience in fabricating and installing piping for more than six million KW's of output—these are among the reasons why "Reheat Power Piping by Kellogg" is so often the specification . . . 10 times within the recent expansion period.

These leading companies are among the many major producers of power who use M. W. KELLOGG POWER PIPING . . .

- Societa Meridionale Di Elettricita (Italy)
- Sociedad De Electricidad De Rosario (Argentina)
- Union D'Electricite (France)
- United Illuminating Co.
- Westinghouse Electric Corp.
- West Penn Power Co.
- Wisconsin Public Service Corp.

OTHER FABRICATED PRODUCTS including: Pressure Vessels . . . Vacuum Vessels . . . Fractionating Columns . . . Drums and Shells . . . Heat Exchanger . . . Process Piping . . . Bends and Headers . . . Forged and Welded Fittings . . . Concrete and Radial Brick Chimneys

FABRICATED PRODUCTS DIVISION
M. W. KELLOGG

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Complete stocks in a wide range of sizes assure you prompt delivery.

The H. M. Harper Company has specialized for almost a third of a century in fastenings of non-ferrous metals and all stainless steels, and is the largest manufacturer in this field. Over 7,000 items are available from stock in aluminum, brass, naval bronze, silicon bronze, Monel and all stainless steels.

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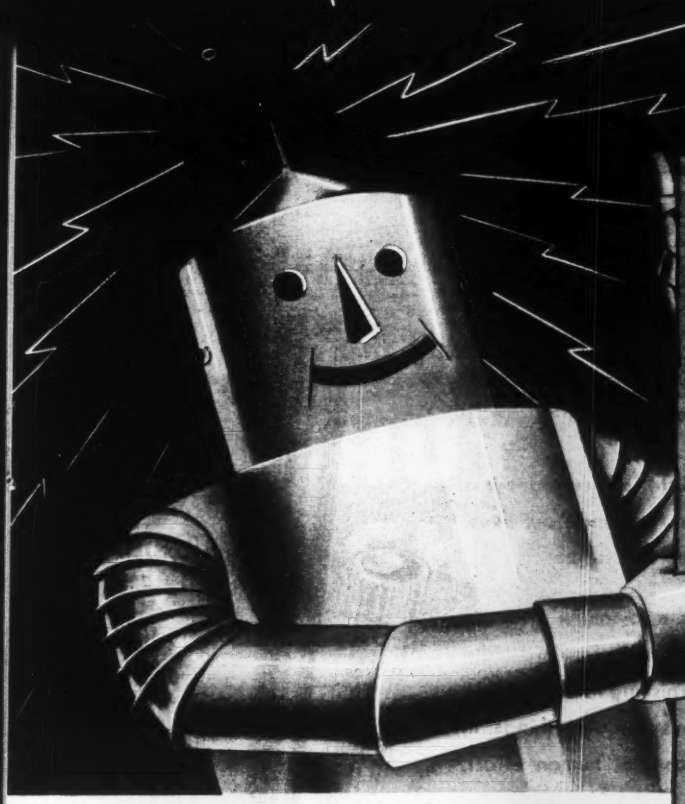


AUTOMATIC

Demineralization and Silica Removal by Ion Exchange Resins

MOTOR and diaphragm-operated valves make regeneration of Permutit Demineralizers fully automatic. This gives more positive control . . . eliminates the possibilities of costly errors . . . saves valuable man-hours formerly spent in regeneration.

In a recent installation for a 1450 psi boiler, two compact Permutit units fill all make-up requirements, regardless of changes in turbine loads . . . deliver a continuous supply of demineralized, silica-free water. What better way to eliminate scale and silica deposits!

HIGHEST PURITY MAKE-UP

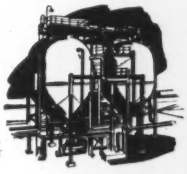
Effluents of Permutit Demineralizers have contained *total* electrolytes as low as 0.01 ppm and silica as low as 0.01 ppm! These values may be slightly higher under service conditions. In comparison, most distilled water contains 20 to 100 times more electrolytes . . . yet costs much more to produce.

INFORMATIVE NEW BULLETIN

You'll want this interesting book. Flow diagrams, illustrations and specifications explain key methods of demineralizing water and removing silica by ion exchange. Write for your copy, today!

THE PERMUTIT COMPANY, Dept. MB-11, 330 West 42nd Street, New York 36, N. Y., or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal, P. Q.

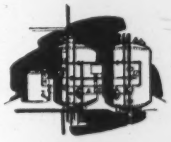
OTHER BASIC WATER CONDITIONING PROCESSES



Sludge Blanket Hot Lime Soda

Full utilization of Permutit sludge-blanket principle assures high efficiency. Reduces hardness to region of 20 ppm . . . silica to 2.0 ppm. Lowers alkalinity . . . removes wide variety of solids.

Hot Zeolite—Permutit Q

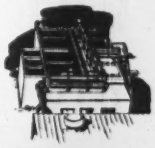


Permutit Q—a styrene base resin resistant to high temperatures and pH values—replaces second stage phosphate treatment in hot-process softener. Results—residual hardness is completely removed at great savings in phosphate costs.

Deaerating Heater

Removes objectionable oxygen and CO_2 to prevent corrosion and pitting of feed lines, stage heaters, economizers, and boilers at high temperatures. Steam is used twice . . . deaerates water completely.

Precipitator



Softens water on space and time-saving sludge-blanket principle. Simultaneously removes turbidity, color, fluorides, reduces silica and lowers alkalinity.

PERMUTIT

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

THIRTY-SEVEN YEARS and YOU

THIRTY-SEVEN YEARS is a long time. Historians consider it a generation. Many things happen in that length of time to change our lives. The passing years add experience that guides our forward steps.

Since the start of our business, thirty-seven years ago, many changes have taken place here at Wolverine. Each has been a step forward—the natural result of experience that has been constantly furnishing the inspiration for us to keep looking ahead in search of better ways of doing things, in order that we may bring you the best tube products that human effort, skill, and modern equipment can provide.

Our efforts are not alone confined to the manufacture of tubing, but also to finding ways and means that will make the application of tube most practical—either in the original tube form or as a fabricated tubular part.

As tube specialists, we interest ourselves in both the production of the tube and its ultimate use. We feel it our responsibility to see that Wolverine tube functions to its fullest capacity. We know how to build the finest tube that skill and equipment can produce. And we can fabricate it in any shapes your specifications demand, from the following metals—copper, copper base alloys, electric-welded steel, and aluminum (2S or 3S).

It is reasonable to believe that our progress can help your progress.

WOLVERINE TUBE DIVISION
of CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing

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Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

EXPORT DEPT., 13 E. 40th ST., NEW YORK 16, N. Y.

Guaranteed TO SHUT TIGHT*

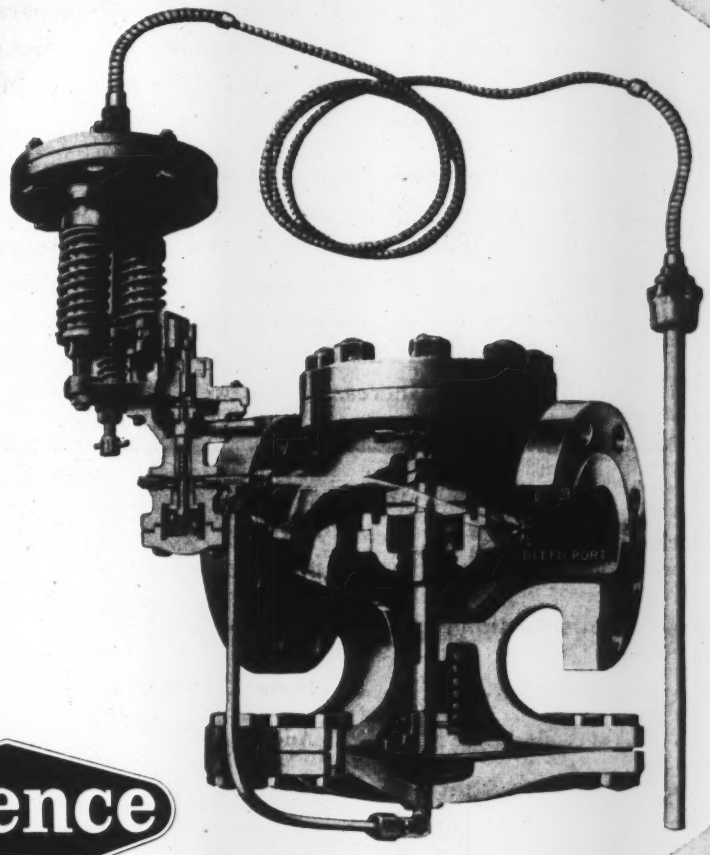
*When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.



SPENCE
TYPE ET150
Temperature
Regulator

Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

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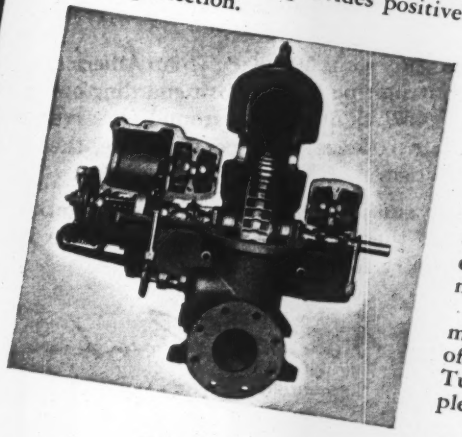
ME-11-53

TERRY

PROTECTION OF TURBINE BLADES made possible by nozzle location

The Terry Solid-wheel Turbine is of the impulse, helical flow type. The steam issues from an expanding nozzle at high velocity and enters the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is returned to the wheel several times until practically all of the energy has been utilized. This principle makes possible the efficient use of steam in a single-piece, almost indestructible wheel.

In the Terry Solid-wheel Turbine, the steam enters the buckets in a direction at right angles to the shaft, as shown above. This design eliminates the need for close clearances and provides positive blade protection.



The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though external thrust should move the wheel.

This is only one of the many important features of the Terry Solid-wheel Turbine. Write for complete details.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1195

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

AMERICA NEEDS YOU
IN THE GROUND OBSERVER CORPS!

© MURAY

HERE'S WHY: The potential of modern military offense is such that a surprise raid against this country could cause tremendous casualties.

Our military defense is aware of this possibility. Air Force interceptor planes and Army anti-aircraft batteries are designed to repel such an attack.

But—if that attack ever comes—*warning must come through in time!* Citizen volunteer plane-spotters—ground observers—play a vital role in providing the necessary warning.

Already some 300,000 civilian Americans are contributing to the job of guarding our ramparts. I salute these Ground Observers for their patience, their perseverance, their patriotism.

But the job calls for twice their number to man these vital posts. Will you serve your country for two hours a week?

Dwight D. Eisenhower

PRESIDENT OF THE UNITED STATES

★

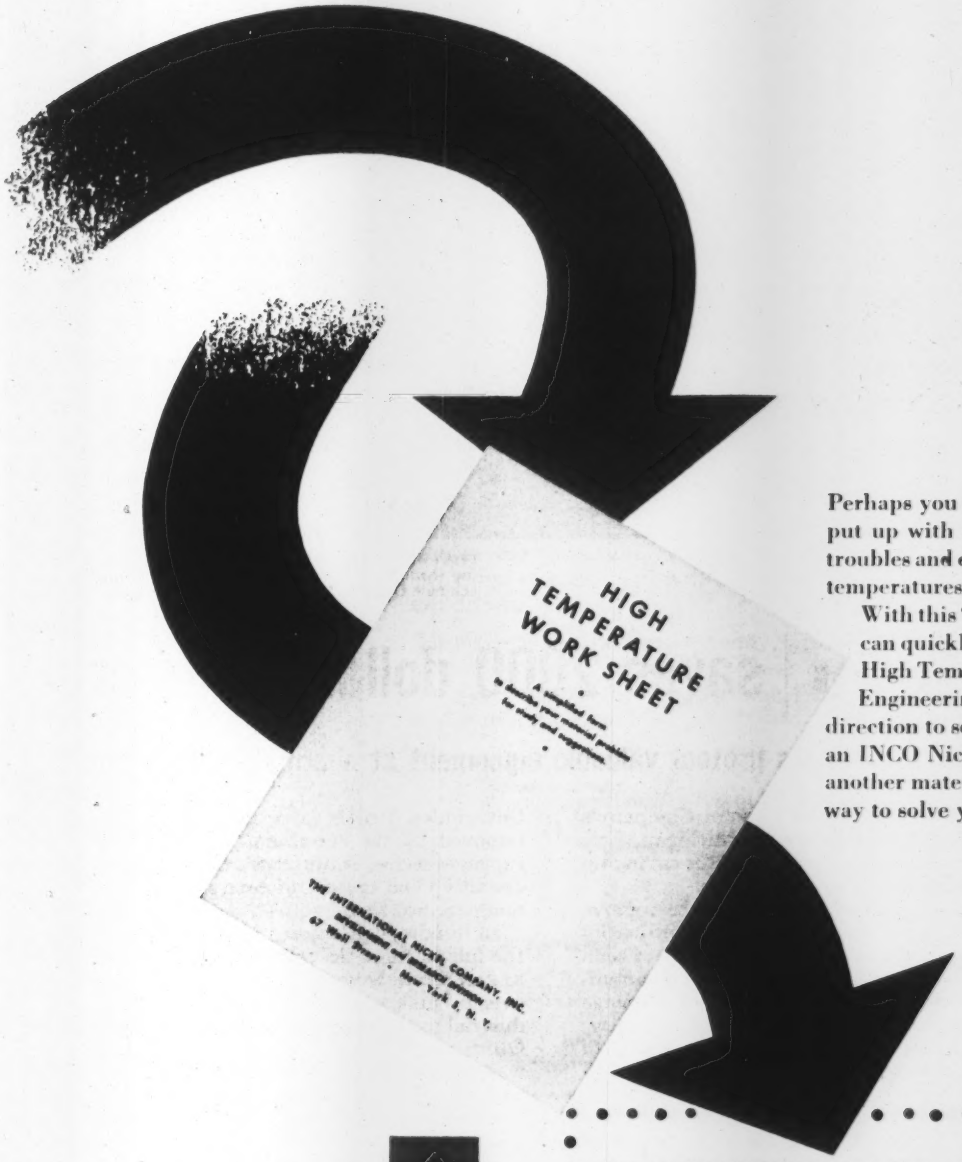
Keep your eye on the sky in the
GROUND OBSERVER CORPS

Call or write your
Civil Defense Director

Wake Up!
Sign Up!
Look Up!

This Way

TO SOLVE YOUR **HIGH-TEMPERATURE** PROBLEM


HIGH TEMPERATURE WORK SHEET
A simplified form to describe your material problem for study and suggestions.
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street • New York 5, N. Y.

Perhaps you no longer need to put up with the repeated troubles and expense that high temperatures can cause.

With this "Work Sheet" you can quickly give INCO's High Temperature Engineering Service the direction to search out whether an INCO Nickel Alloy or another material is a practical way to solve your problem.

EMBLEM OF INCO SERVICE

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Please send me the High-Temperature Work Sheet.

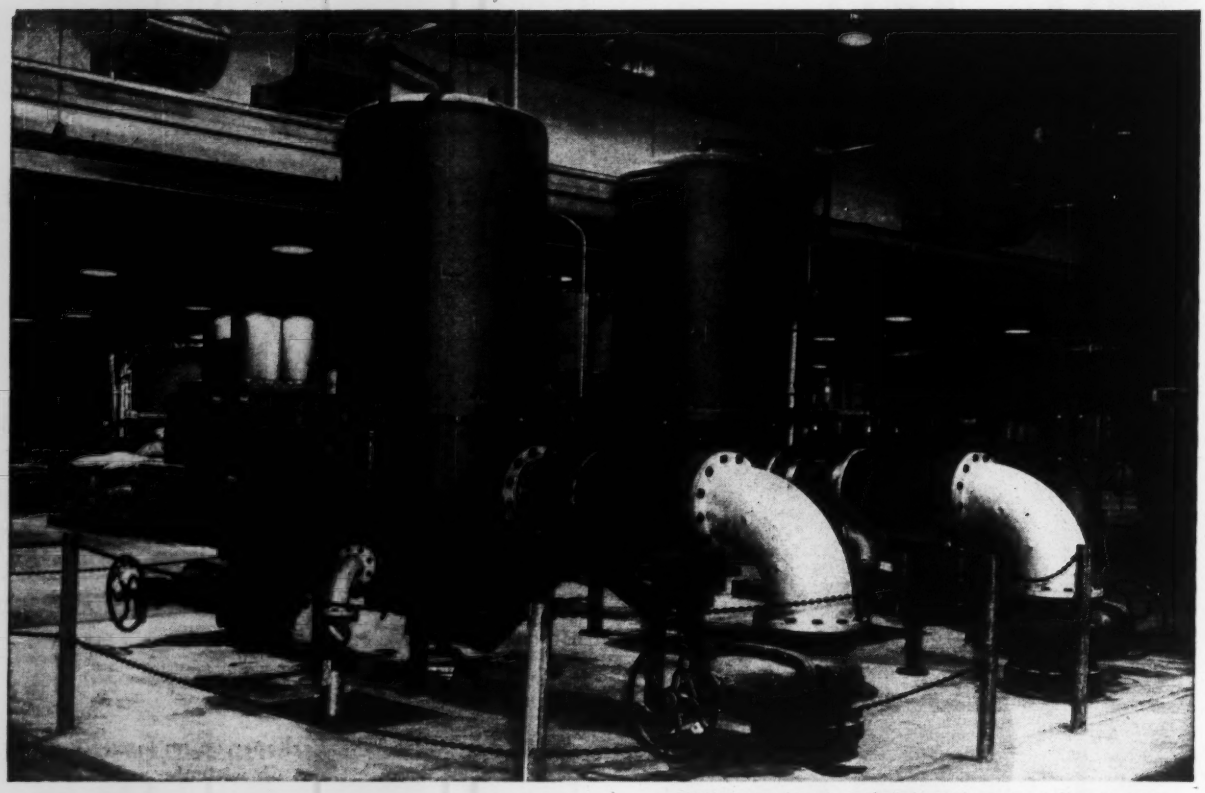
Name_____ Title_____

Company_____

Address_____

City_____ State_____

ME*11-53



EVERY GRAIN OF SAND IS REMOVED from the well water passing through these abrasion-resistant FLO-KLEAN filters at the new Upjohn Company plant in Kalamazoo, Michigan.

Upjohn saves 2000 dollars a month

FLO-KLEAN filters protect valuable equipment at pharmaceutical plant

Maintenance records at the Upjohn Company's ultra-modern plant near Kalamazoo, Michigan, show that FLO-KLEAN filters are responsible for saving up to $2000 a month in maintenance costs.

These Cuno FLO-KLEAN filters, used to remove sand and gravel from incoming well water, ordinarily take something like a teaspoon of sand out of each thousand gallons. That doesn't appear to be an impressive quantity, but it could cause serious damage to stainless steel valves, pumps, water softeners, condensers and other valuable equipment. Purity of process water is assured by the high-capacity FLO-KLEAN units.

Recently the wall of one of their thirteen 250 feet deep wells gave way, dumping large quantities of sand and gravel into the water system. Every bit of this sudden deposit (almost seven cubic yards) was removed by the FLO-KLEAN filters. Without interrupting service, FLO-KLEAN continued its automatic operation and saved Upjohn a serious operating and maintenance loss.

In hundreds of applications throughout industry the fully automatic, continuously self-cleaning FLO-KLEAN filters have paid for themselves many times over by making river, lake, or well water fit for industrial use . . . and without loss of backwash water. Other uses include reclaiming industrial process water and coolants. If you need or use between 200 and 100,000 gallons per minute of clean water, find out how FLO-KLEAN can save you money. Write for free FLO-KLEAN bulletin to the Cuno Engineering Corporation, Dept. 651F, Meriden, Conn. 3.1

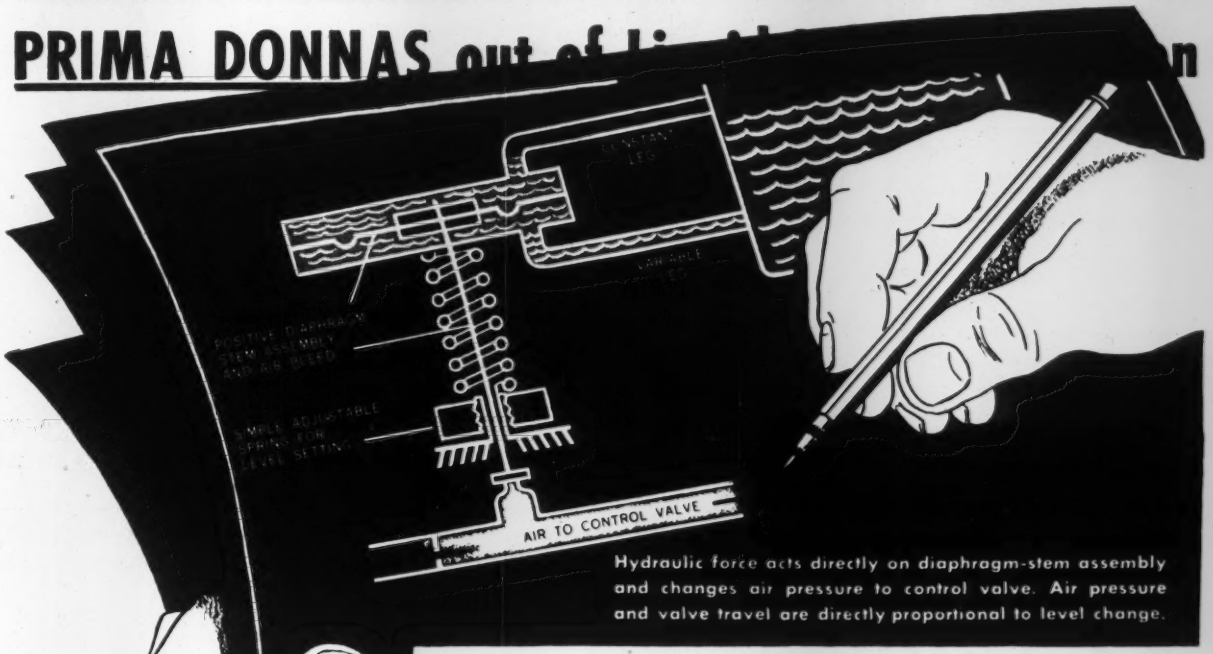
CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

LESLIE *Floatless* Level Control takes the PRIMA DONNAS out of li... ...n



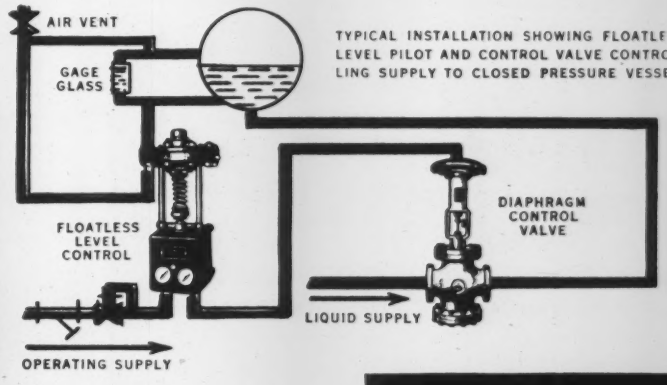
Hydraulic force acts directly on diaphragm-stem assembly and changes air pressure to control valve. Air pressure and valve travel are directly proportional to level change.

Here is level control that is not affected by surface agitation, equipment vibration, or the roll of a ship—a simple design that provides steady, positive, precise control even under extreme conditions.

Thousands are in service today, providing accurate control of liquid level (plus or minus 1" water column) and eliminating the problems caused by troublesome linkages, torque tubes, floats and stuffing boxes.

Note these special features—

1. **Can be installed anywhere below liquid level . . . on control panel, if desired.**
2. **Simple, compact, one adjustment unit . . . weighs only 40 lbs.**
3. **Diaphragm stem assembly is only moving part. Diaphragm element doesn't require recalibration during service.**



TYPICAL INSTALLATION SHOWING FLOATLESS LEVEL PILOT AND CONTROL VALVE CONTROLLING SUPPLY TO CLOSED PRESSURE VESSEL

SEND FOR DESCRIPTIVE DATA PC-37

When specifying . . .

Here's *another* LESLIE *standard* item to fit specifications that are *special* orders with most manufacturers. When specifying pressure, temperature or level controls—for new or replacement service—it will pay to check *first* with your nearest LESLIE engineer. He's listed in the classified telephone directory in principal cities . . . under "Regulators" or "Valves"

LESLIE

TOPS IN QUALITY PRESSURE LEVEL AND TEMPERATURE CONTROLS

Since 1900

LESLIE CO., 287 Grant Avenue, Lyndhurst, New Jersey

ACCURATE
EASY READING
MANOMETERS

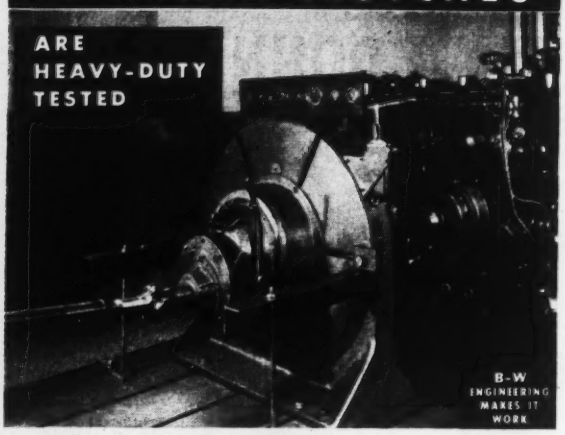
For precise reading as well as for accurate measurements choose Trimount Manometers.

Sturdy construction—long lasting—used for many purposes—Multiple Tube, Well Type, U Tube, etc. Also custom made to your specifications.

Write for illustrated Bulletin B

Trimount
INSTRUMENT CO.
3119 WEST LAKE STREET • CHICAGO 12, ILLINOIS

ROCKFORD CLUTCHES



Large ROCKFORD clutches, Power Take-Offs and Speed Reducers are tested for torque, engaging pressure, release, temperature, gear strength, bearing endurance and clutch facing wear on this 400 H.P. diesel powered, electric dynamometer. Let ROCKFORD engineers utilize this machine to improve your heavy-duty power transmission controls.

B-W
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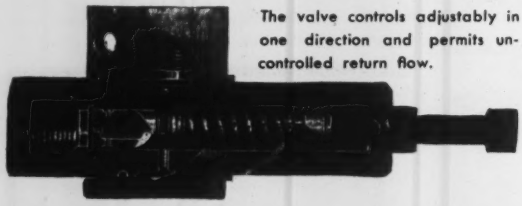
MAKES IT
AVAILABLE

ROCKFORD CLUTCH DIVISION BORG-WARNER
1307 Eighteenth Avenue, Rockford, Illinois, U. S. A.

An Adjustable

FLOW REGULATOR

This newly perfected adjustable Flow Regulator holds at a constant rate even though the pressure fluctuates.



The valve controls adjustably in one direction and permits uncontrolled return flow.

The spring back piston in the housing is mounted in front of the adjustable screw. It carries a calibrated orifice; operates axially on change in inlet pressure so as to increase the throttling action.

Four sizes, ¼, ⅜, ½, and ¾ inch. Overall length 4½ to 7½ inches. Adjustable over a 50% flow range. Maximum pressure is 3000 pounds.

Write for illustrated circular G.

WATERMAN ENGINEERING Company
725 CUSTER AVENUE
EVANSTON ILLINOIS

MECHANICAL ENGINEERING

October, 1953 CARD INDEX Vol. 75, No. 10

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All materials . . . all types of gears . . . made to specifications only.

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SYRACUSE 1, NEW YORK

DIEFENDORF GEARS

for trouble-free service

GRINNELL

STAINLESS STEEL WELDING FITTINGS and FLANGES

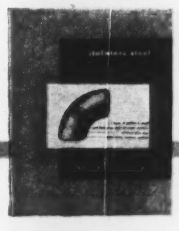
To help combat mounting costs in the installation and maintenance of piping systems where corrosive or certain other service conditions are involved, Grinnell offers a comprehensive range of welding fittings and flanges in stainless steel.

- **To prevent corrosive attack.**
- **To obtain adequate impact resistance at low temperatures and sufficient creep strength at high temperatures.**
- **To provide sanitary conditions.**
- **To avoid contaminating the product.**

Grinnell welding fittings and flanges are available in types 304, 347 and 316. These are in the chromium-nickel grades known as "18-8". The corrosion resistant properties of stainless steels are primarily due to the chromium content which ranges from 17% to 20%. The addition of nickel in ranges from 7% to 14% improves the corrosion resistance as well as the properties at elevated temperatures. A molybdenum addition of 2% to 3%, as found in type 316, increases the resistance to sulphurous and phosphoric acids, brine and hypochlorite solutions, and improves the general resistance to other corrosive liquids, as well as improving the physical properties at elevated temperatures. A columbium addition of approximately 0.4% to 1.0%, as found in type 347, creates non-susceptibility to carbide precipitation which can cause intergranular corrosion.

In addition to stainless steel, Grinnell offers welding fittings and flanges in carbon steel, nickel, Inconel, Monel, aluminum and brass.

Write for new booklet giving complete data on Grinnell stainless steel welding fittings and flanges. No obligation.



stainless steel welding fittings
Types 304, 347, 316

DESCRIPTION	SCHEDULE†	PIPE SIZE, IN.‡
90° Long Radius Elbow 45° Long Radius Elbow 180° Long Radius Return Straight Tee	5s, 10s, 40s, 80s	½ to 12
Reducing Tee	5s, 10s, 40s, 80s	¾ to 12
Cross (Straight and Reducing)	5s, 10s, 40s, 80s	1¼ to 12
Concentric Reducer Eccentric Reducer	5s, 10s, 40s, 80s	¾ to 12
Lateral (Straight or Reducing)	5s, 10s, 40s, 80s	1 to 12
Cap	5s, 10s, 40s, 80s	½ to 12
Lap Joint Stub End-Long	10s, 40s, 80s	½ to 12
Lap Joint Stub End-Short	5s, 10s, 40s,	½ to 12

† 5s is Featherweight, 10s Lightweight, 40s Standard, 80s Extra Strong.
‡ Larger sizes available on special order.

stainless steel flanges

150 lb. and 300 lb. Steel Flange Standard *(Higher series available on application).*

DESCRIPTION	PIPE SIZE, IN.
Welding Neck Slip-on Lap Joint Threaded Socket Type Blind	½ to 24

150 lb. Corrosion Resistant Standard. *(For use with schedule 10s and 5s pipe. Rated at 150 psi at 500°F, 225 psi at 150°F, when used with full-faced gaskets).*

DESCRIPTION	PIPE SIZE, IN.
Buttwelding Slip-on Blind	½ to 12

GRINNELL
WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • **Coast-to-Coast Network of Branch Warehouses and Distributors**

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

In Gerotor hydraulic pumps . . . and motors . . . the GEROTOR* makes the difference!

The patented Gerotor principle is represented by a pair of gear-shaped elements, one within the other. In pumps, power is applied through the shaft to the inner Gerotor and is transmitted in the closed mesh region to the outer Gerotor; in motors, the same principle operates in reverse.

Each tooth of the inner Gerotor is in sliding contact with the outer Gerotor at all times, providing continuous fluid-tight engagement at very low contact speed. The contact points revolve only once in seven to nine revolutions, depending on the type of unit. This reduced friction permits higher shaft speeds, assures longer life. Opening and closing of chambers between the teeth is gradual across long ports, eliminating sudden shock and excessive turbulence, and reducing pressure variations found in conventional gear pumps. In Gerotor hydraulic pumps and motors, the Gerotor principle produces high volumetric and mechanical efficiency.

Whatever your need in hydraulic pumps or motors consult the Gerotor May engineers. *Write for free literature.*

**Gerotor is not just a name . . . it's the heart of the finest hydraulic pumps and motors made.*

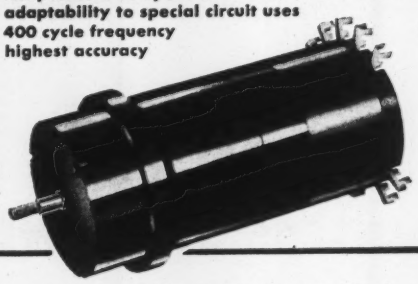
GEROTOR MAY CORP., BOX 86, BALTIMORE 3, MD.

The two Gerotors revolve at different speeds, resulting in a continuous opening and closing of spaces as shown in this diagram. Follow the changing position of tooth #1 as rotation takes place. Note its relation to space #2. As rotation continues, tooth #1 gradually displaces oil from space #2, thus creating pressure.

GEROTOR
HYDRAULIC PUMPS & MOTORS

ELECTRICAL RESOLVERS

- interchangeability
- temperature compensation — 60°F to +160°F
- adaptability to special circuit uses
- 400 cycle frequency
- highest accuracy



Now you can get the same Ford Electrical Resolvers, precision-built to the highest degree of operating efficiency for our own quality computers and automatic control equipment . . . to meet *your* extra special requirements.

FREE — fully illustrated brochure gives more details, describes Ford Instrument resolver systems. ***SEND FOR YOUR COPY TODAY!*** Write Dept. ME-1.

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CAPACITY FROM 300,000 to 7,500,000 B.T.U. per hour

- Maximum four pass heat transfer surface.
- Separate induced draft fan.
- Easy accessibility to accessories.
- Popular parts easily obtained anywhere.
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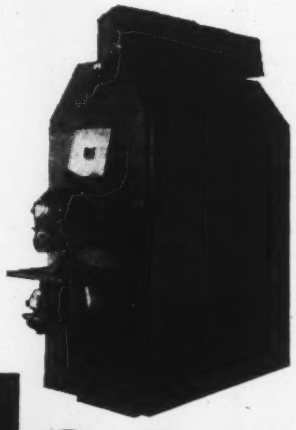
- Flexibility for special adaptions.
- Low initial cost.



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DIRECT FIRED HEATERS
Gas, Oil, Coal or Dual Gas and Oil

ARTHUR A. OLSON & COMPANY
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THIS BOOK . . . will answer all your BRONZE CASTING PROBLEMS

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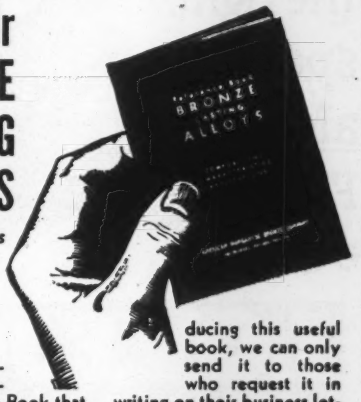
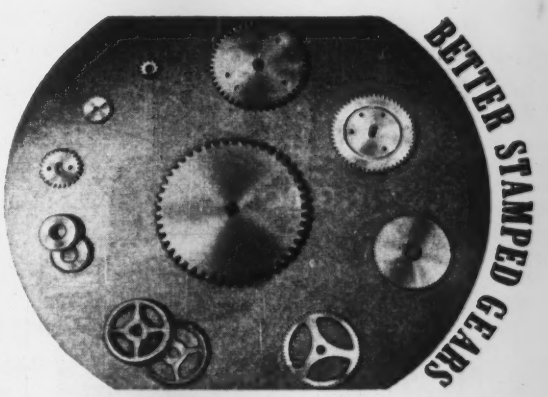


A 46-page, flat-opening, flexible-bound Reference Book that should be in the hands of every Engineer who specifies or uses Bronzes. Due to the cost of preparing and producing this useful book, we can only send it to those who request it in writing on their business letterheads—and remember, there's over 43 years "specialized experience" behind us in casting Bronzes.

AMERICAN MANGANESE BRONZE COMPANY

4703 RHAWN ST., HOLMESBURG, PHILADELPHIA 36, PA.

Established 1909



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***WRITE FOR FREE** folder describing our facilities, assemblies, and various Stamped Gears. Includes data and tables. Samples, ideas, quotations, for the asking.*

WINZELER *Stamped Gears*

WINZELER MANUFACTURING & TOOL CO.

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Engineers

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Paid vacations, liberal health and life insurance coverage. Premium is paid when longer work week is scheduled.

ENGINE AND AIRPLANE CORPORATION

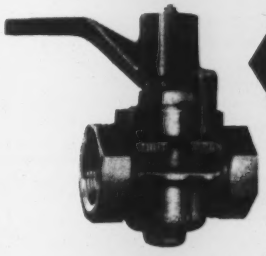
FAIRCHILD *Aircraft Division*

HAGERSTOWN, MARYLAND

VALVES THAT DON'T LEAK!

The exclusive eccentric action of DeZurik Valves delivers a full-open flow or dead-shut closure without binding or scoring, on a smooth quarter-turn. They operate without friction—close, rubber-to-metal, without pinching—require no lubrication.

A PIPE-DREAM FOR ENGINEERS

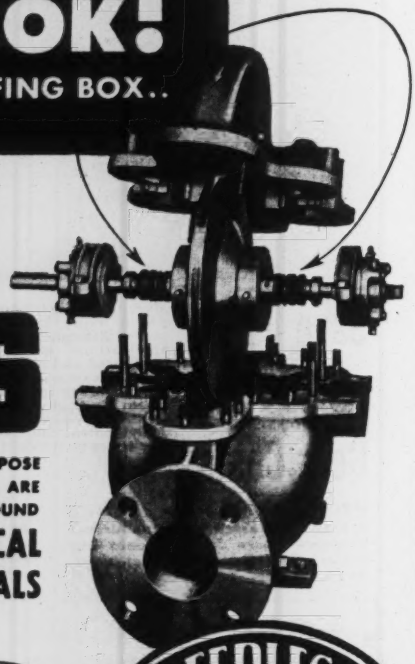


DeZurik Valves are manufactured in a full range of sizes and metals to handle almost anything that's piped. Write for details and service recommendations to:

DEZURIK SHOWER CO. SARTELL, MINN

LOOK!

NO STUFFING BOX..



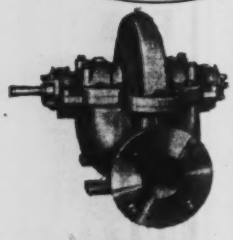
Peerless type AS

GENERAL PURPOSE PUMPS ARE DESIGNED AROUND

MECHANICAL SHAFT SEALS

HERE ARE 4 BIG ADVANTAGES

PEERLESS PUMPS



1. NO LEAKAGE. Simple, positive acting, shaft seals prevent leakage of liquid from pump.

2. LESS MAINTENANCE. Stuffing box is completely eliminated; maintenance trouble and expense is reduced to the minimum.

3. CUSTOM PUMP—STANDARD PRICE. The Peerless Type AS pump costs no more than ordinary split-case pumps. You get extra quality without paying a premium.

4. EASILY SERVICED. Entire rotating element can be removed from pump without disturbing line connections. Shaft seals and bearings are standard items, easily available from commercial sources.

WRITE FOR BULLETIN No. B-1350 which completely describes and illustrates the modern design and construction features of Peerless Type AS pumps.

PEERLESS PUMPS fmc

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send us a copy of Bulletin No. B-1350 describing Peerless Type AS pumps.

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

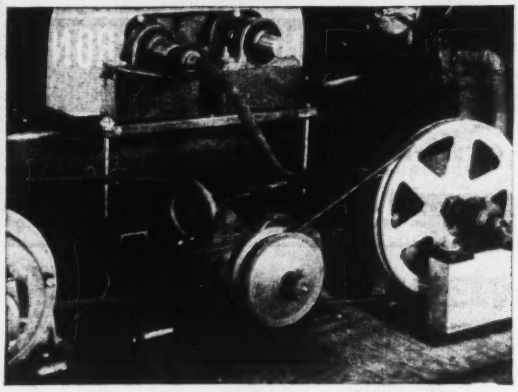
M.E.

the right speed always to FIT THE JOB!

LOVEJOY

SELECT-O-SPEED

Variable Speed Transmissions



A Select-O-Speed Transmission is used here to drive and control the speed of a pulley and flexible shaft connected to a vibrator that checks vibration of vehicular components at changing speeds.

Lovejoy's accurate, easily installed Select-O-Speed Transmission gives you complete and instant speed control on all types of machinery—new or old. Even while the machine is running you can adjust to an almost infinite number of speed variations.

Adjustments for testing . . . operator ability . . . variously sized parts or stock . . . material differences . . . any other operational variables . . . can be accomplished without loss of time or labor.

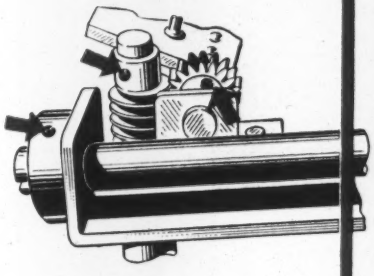
Lovejoy Select-O-Speed Transmissions provide better, more efficient production control to help you improve the quality of your products.

Speed ratios to 10 to 1. Fractional sizes up to 5 hp. Hand lever or wheel control. Operate with standard V-Belt drives. Fully enclosed. Send now for illustrated catalog giving complete information.

LOVEJOY FLEXIBLE COUPLING CO.

5032 W. Lake Street **Chicago 44, Illinois**

Mfrs. of flexible couplings, universal joints, variable speed pulleys and variable speed transmissions.



A typical application, not included in the pilotless bomber above. Rollpin is driven into standard holes, compressing as driven. No taper reaming is required. Rollpin fits flush . . . is vibration-proof.

ROLLPINS saved The Glenn L. Martin Co. $6,300

The Glenn L. Martin Company cut fastening costs on a single missiles contract by $6,300, as compared to dowel pins . . . by $11,700 as compared to taper pins! These installed cost savings, recently announced to Company engineers, were made possible by the use of just 90 Rollpins per unit.

ESNA Rollpin is the slotted tubular steel pin with chamfered ends. It is simply driven into standard holes, compressing as driven. The Rollpin's spring action locks it in place—regardless of impact loading, stress reversals or severe vibration—that's why Martin was able to make these savings on this contract for pilotless bombers.

No precision-drilling, threading or peening . . . no extra operations!

If you use locating dowels, hinge pins, rivets, set screws . . . or straight, knurled, tapered or cotter-type pins—Rollpin can cut your costs, too. Just mail the coupon for design information.

Dept. R21-1111, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send the following free fastening information:

☐ Rollpin Bulletin

☐ Elastic Stop nut bulletin

☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone___ State_____

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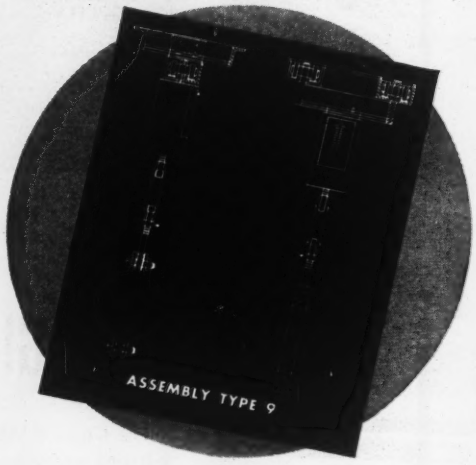

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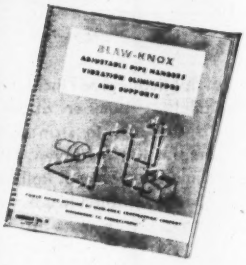

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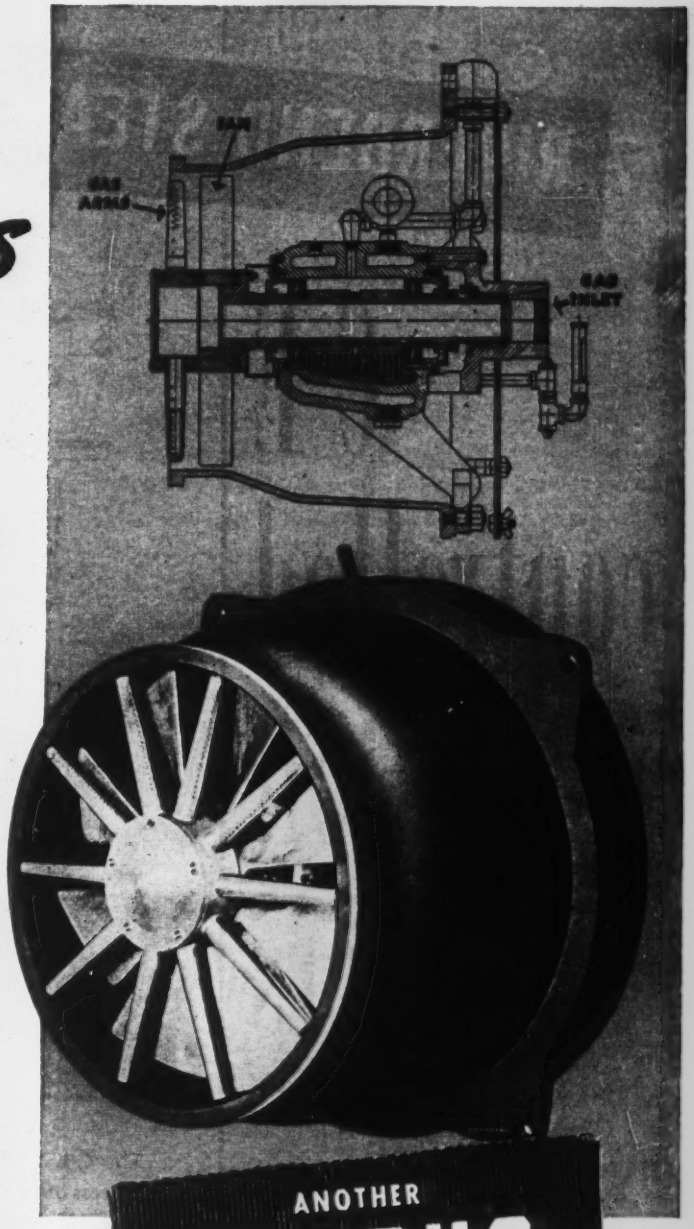

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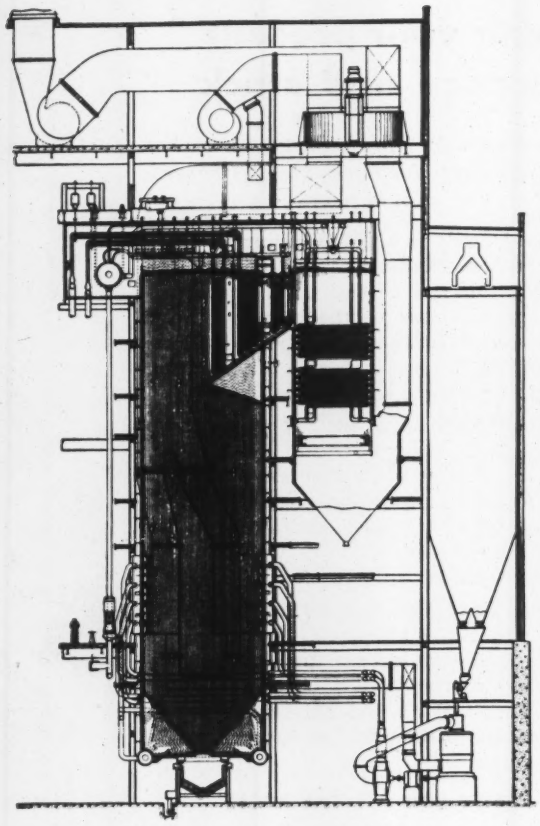

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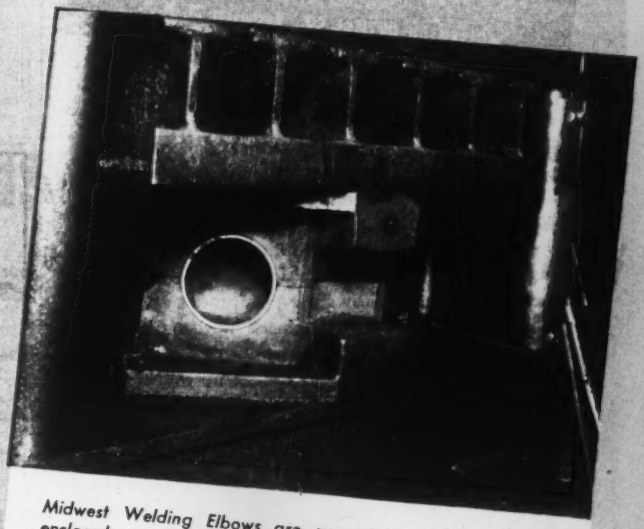

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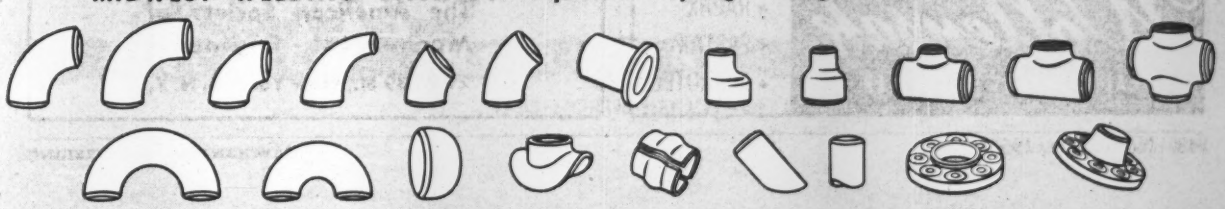

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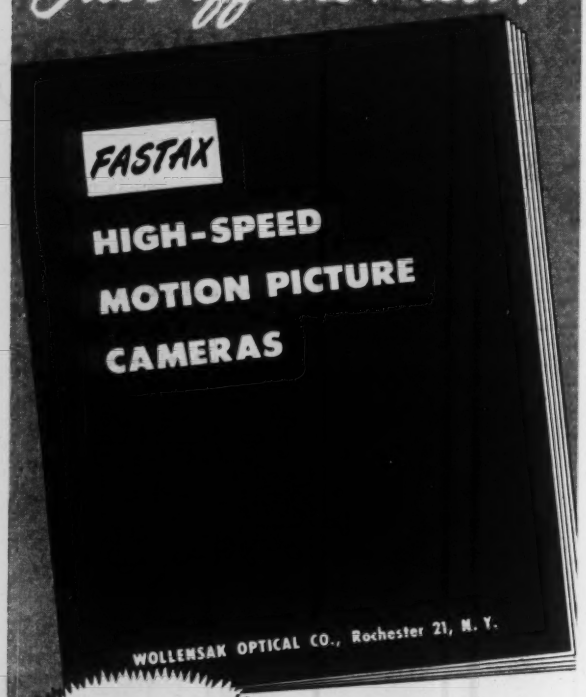

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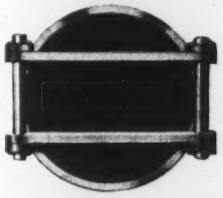

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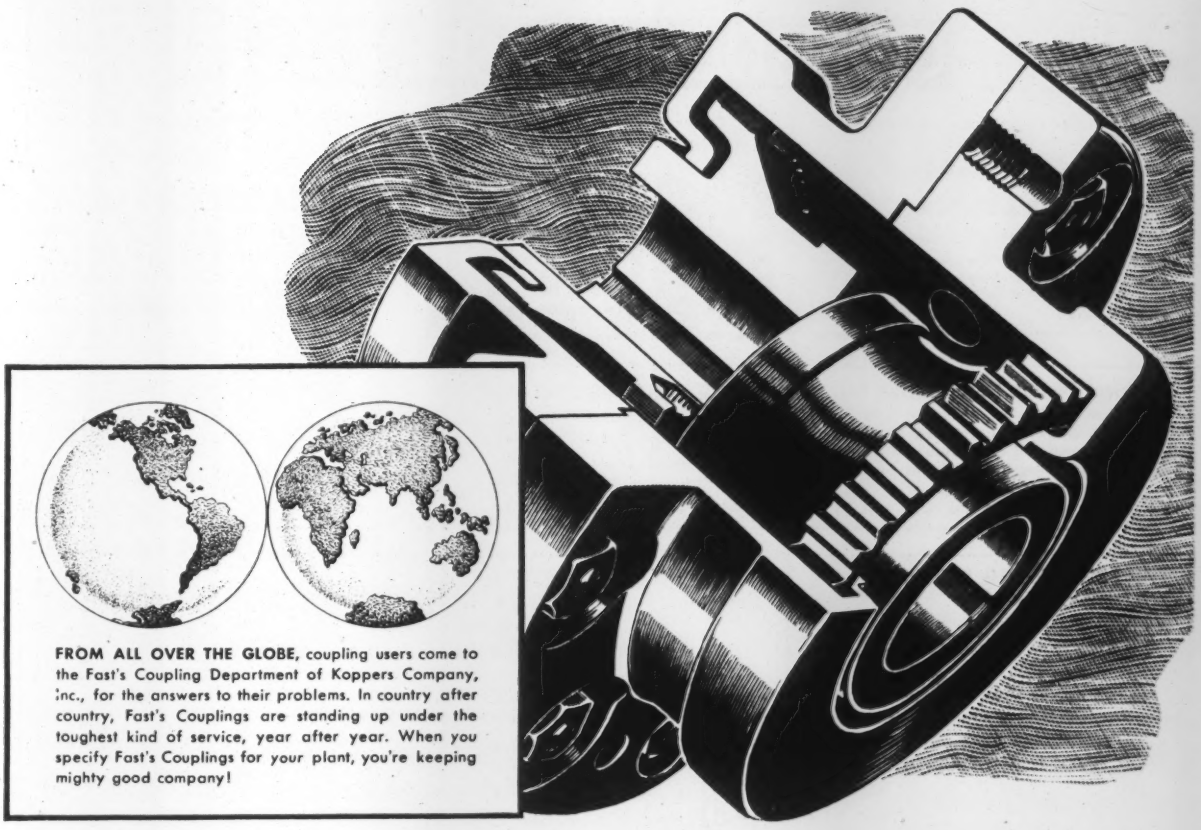

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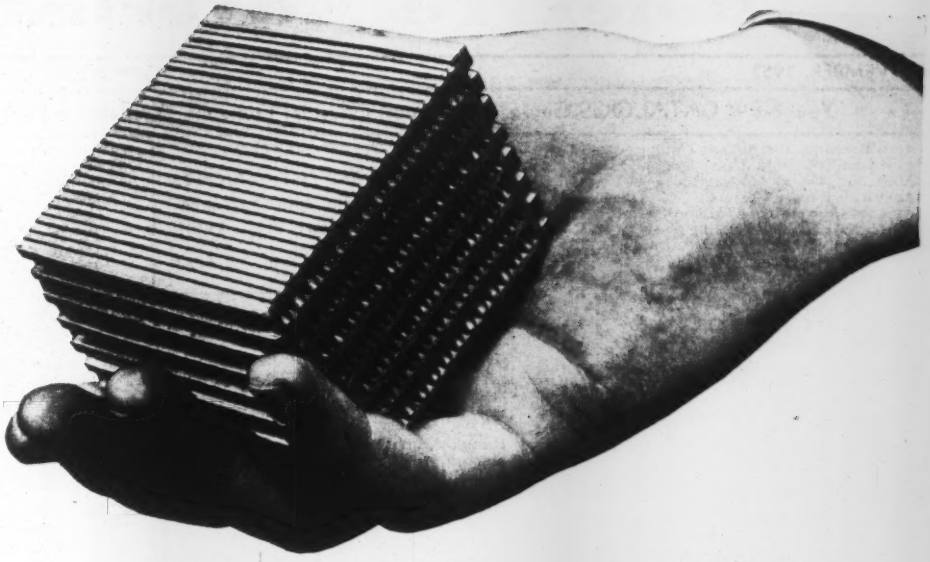

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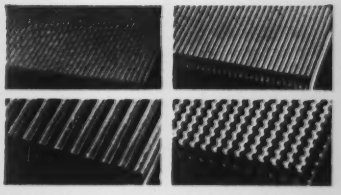

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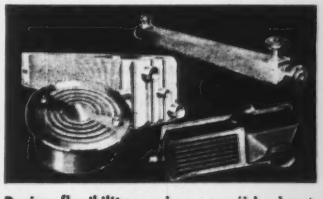

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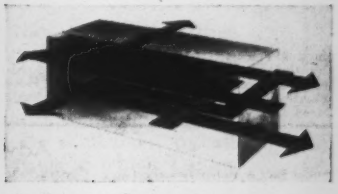

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*Peabody Engineering Corp.
Photoswitch (Inc.)
Pittsburgh Piping &
Equipment Co.
*Posey Iron Works (Inc.)
Post, Frederick, Co.

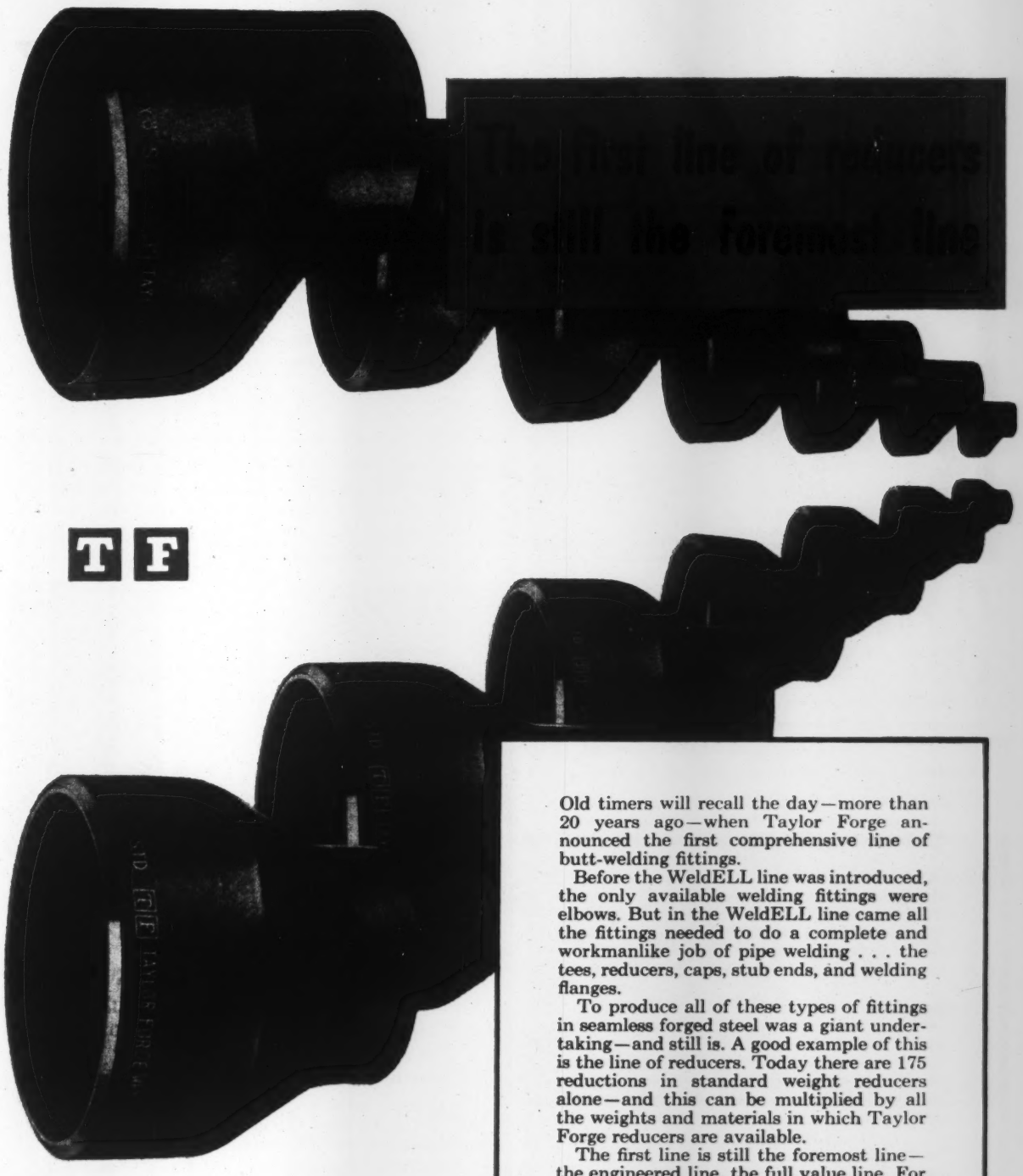
*R-S Products Corp.
Reeves Pulley Co.
Reliance Electric & Engrg. Co.
*Republic Flow Meters Co.
Research Corp.
Resolite Corp.
Rust-Oleum Corp.
*SKF Industries (Inc.)
*Seamless Co.
Servel (Inc.)
*Shafer Bearing Co.
*Sier-Bath Gear & Pump Co.
Sponge Rubber Products Co.
Spraying Systems, Co.
Standard Locknut & Lockwasher
Sterling Electric Motors (Inc.)
Streeter-Amet Co.

Taylor Dynamometer &
Machine Co.
Trabon Engineering Corp.
*Tube Turns (Inc.)

Uniflow Mfg. Co.
*United States Steel Co.

Vickers (Inc.)
Div. Sperry Corp.
*Voss, J. H. H., Co.

*Western Gear Works
Wheeler, C. H. Mfg. Co.
Wiley, John & Sons
Williams Gauge Co.
Wisconsin Motor Corp.



T F

Old timers will recall the day—more than 20 years ago—when Taylor Forge announced the first comprehensive line of butt-welding fittings.

Before the WeldELL line was introduced, the only available welding fittings were elbows. But in the WeldELL line came all the fittings needed to do a complete and workmanlike job of pipe welding . . . the tees, reducers, caps, stub ends, and welding flanges.

To produce all of these types of fittings in seamless forged steel was a giant undertaking—and still is. A good example of this is the line of reducers. Today there are 175 reductions in standard weight reducers alone—and this can be multiplied by all the weights and materials in which Taylor Forge reducers are available.

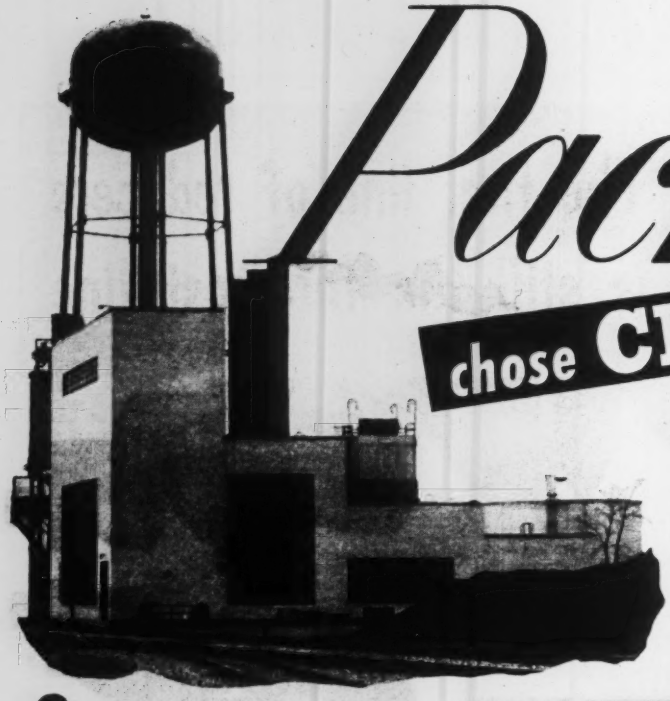
The first line is still the foremost line—the engineered line, the full value line. For up-to-the-minute facts about the WeldELL line, see your Taylor Forge Distributor.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS

General Offices & Works • Chicago 90 • P. O. Box 485

Plants at: Carnegie, Pa., Fontana, Calif., Gary, Ind., Hamilton, Ont., Canada



Packard chose CLARAGE

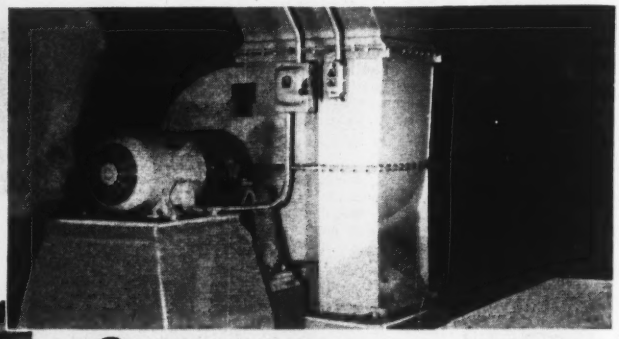
This is the new Packard Motor Car Company power plant in Utica, Michigan—expertly designed to generate steam at lowest cost.

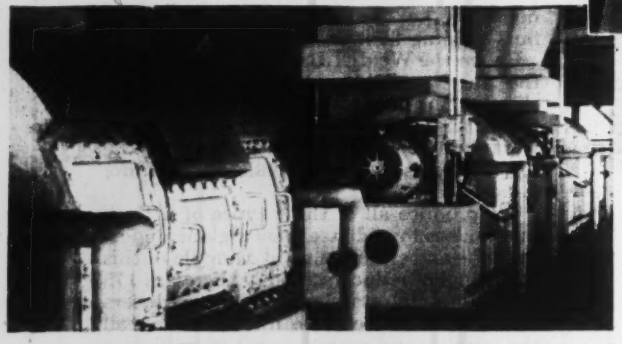
Packard installed Clarage heavy-duty draft fans — *a very wise decision!*

. . . for as the years go by, Clarage fans will pay off time and time again — meeting varying load demands *exactly*, operating *more economically*, giving round-the-clock service with an *extraordinary freedom* from maintenance and repairs.

3 FORCED DRAFT FANS

OPERATING DATA: — Each forced draft fan (equipped with Clarage Vortex capacity control) has a certified rating of 11,000 c.f.m. of standard air at 3" static pressure when operating at 1160 r.p.m.





3 INDUCED DRAFT FANS

OPERATING DATA: — Each induced draft fan (equipped with Clarage water-cooled bearings) has a certified rating of 18,000 c.f.m. of flue gases at a temperature of 560° F. when operating at 1160 r.p.m.

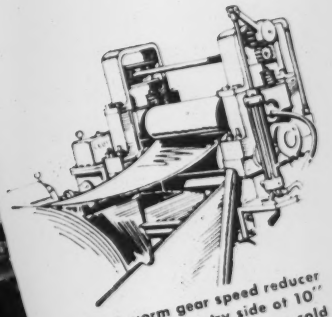
Want to know the secret of the superior performance you get from Clarage fans? Then write for the Clarage Service Manual — which tells all! 78 pages of valuable information on your BEST BUY in air handling and conditioning equipment. Clarage Fan Company, Kalamazoo, Michigan.

You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA Canada Fans, Ltd., 4285 Richelieu St., Montreal



Cleveland worm gear speed reducer drives coil box on entry side of 10" & 26" x 28" 4-high reversing cold mill and Cleveland worm gearing operates screwdowns. Illustration by courtesy of the Lewis Machinery Division of Blaw-Knox Co.

WORM GEARING—universal in its application—affords advantages for almost every power transmission job. Select drives to meet your need from the complete Cleveland line.

CLEVELANDS help roll steel orders to exact "specs"

THIS 4-high reversing cold strip mill rolls steel to exact specifications—width, gauge, temper and finish. To insure smooth delivery of strip to the mill, the builder installed a Cleveland worm gear speed reducer on the coil box. Two sets of Cleveland worms and gears are used for the screwdowns, to control raising and lowering the reduction rolls. Thus from start to finish, Clevelands are at work helping to roll orders to customers' exact specifications.

Machinery builders and users alike find that Clevelands transmit power with a uniform, uninterrupted torque flow throughout their remarkably long lifetime. Cleveland case-hardened steel worms meshing on nickel-bronze gears actually improve with use. Thus Cleveland efficiency never diminishes even after years of service.

Before you decide on drives for your machines, be sure you have the latest information on Cleveland worm gearing. Write for new Catalog 400. The Cleveland Worm and Gear Company, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

Gets greater accuracy in heavy duty threading... *with spindle on TIMKEN® bearings*

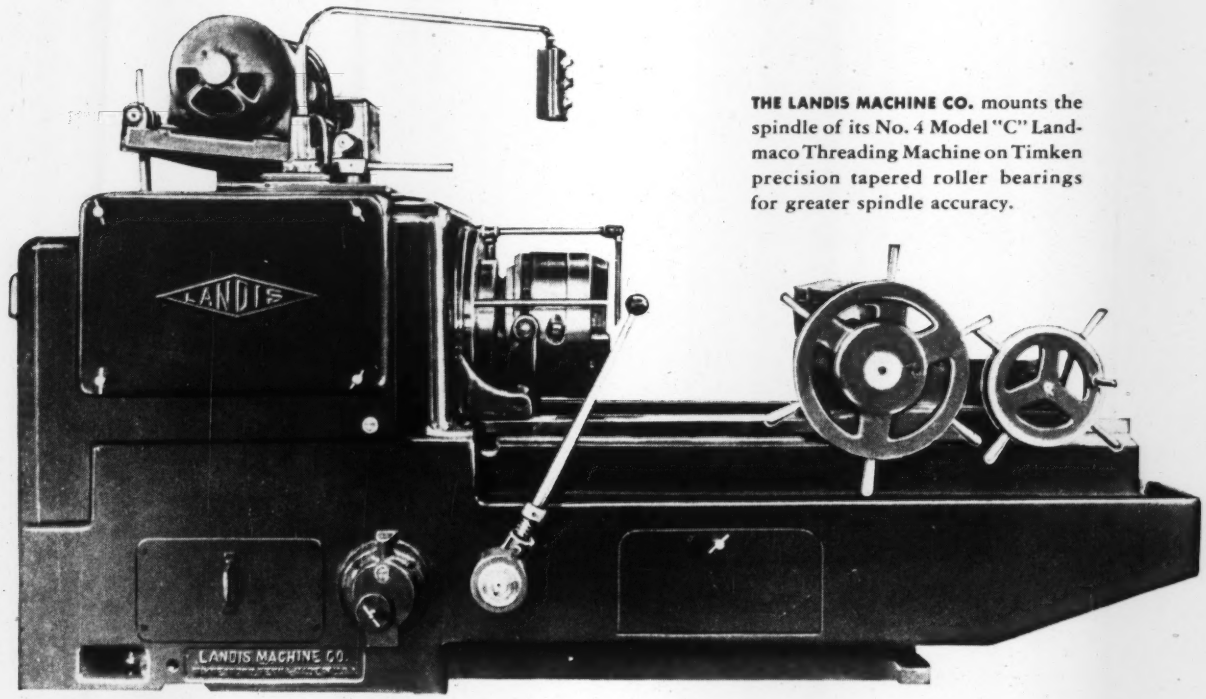
THE Landis Machine Company designed their No. 4 Model "C" Landmaco Threading Machine for heavy duty precision threading on large diameter work. To make sure it delivers that precision, Landis engineers mount the spindle on Timken® precision tapered roller bearings.

Designed for spindle applications, these Timken bearings maintain spindle precision and accurate gear mesh no matter how heavy the load. Timken roller bearings are tapered in construction to take radial, thrust and combination loads. Line contact between rollers and races provides maximum capacity. Shafts are held in rigid alignment. Proper gear meshing is assured. Shaft wear is eliminated, gear wear reduced.

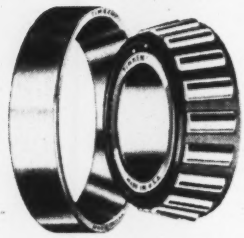
Timken bearings normally last the life of the machine because they're engineered for the job, precision manufactured and made of special analysis Timken fine alloy steel.

For over 25 years, Timken bearings have contributed to the development of precision machine tools. Be sure you have them in the machine tools you build or buy. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

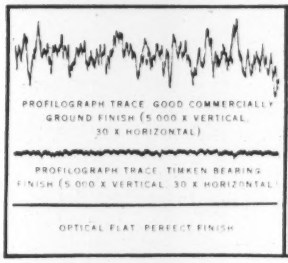


THE LANDIS MACHINE CO. mounts the spindle of its No. 4 Model "C" Landmaco Threading Machine on Timken precision tapered roller bearings for greater spindle accuracy.



TIMKEN

TAPERED ROLLER BEARINGS


PROFILOGRAPH TRACE, GOOD COMMERCIALLY GROUND FINISH (5,000 X VERTICAL, 30 X HORIZONTAL)
PROFILOGRAPH TRACE, TIMKEN BEARING FINISH (5,000 X VERTICAL, 30 X HORIZONTAL)
OPTICAL FLAT, PERFECT FINISH

SMOOTH TO MILLIONTHS OF AN INCH

Surface finish of high quality Timken bearing rollers and races is so smooth that it takes a profilograph to measure its smoothness. This instrument measures surface variations to a millionth of an inch, as shown at the left.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ◐ AND THRUST ◑ LOADS OR ANY COMBINATION